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The anatomy of our anatomy: how humans and their relatives came to be

S001

Nature's great experiment: The development and evolution of the human larynx

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While all people are created equal, all body parts are not. Simply put, some are more important than others both to an individual's development and to a species success. Amongst the most crucial of these is the larynx. As obvious as the lump in your throat, this invaluable structure receives relatively little public attention. Yet the larynx is integral in, and sits at the crossroads of, our breathing, swallowing, pressure-control, aeration, olfactory, and speech generating pathways. Its coordinated neural and structural functioning is integral for proper aerodigestive tract activities. Multi-disciplinary data have shown that humans exhibit many highly specialized, potentially unique, features of the larynx and its milieu that seminally affect our development, and that miscues in development may relate to species-specific clinicopathologies such as the Sudden Infant Death Syndrome. Similarly, comparative anatomical/physiological and paleontological research has allowed for glimpses into the role of laryngeal evolution in our ancestors, and the effect that this has had on who amongst our ancestors has prevailed. Indeed, the unique evolutionary trajectory of our larynx has played a major role in the acquisition of the human vocal tract and our speech capabilities. While much still remains unknown regarding the larynx, its centrality in both development and evolution is becoming ever clearer.

S002

The Atapuerca sites, at the crossroads of European prehistory

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The Sierra de Atapuerca (Burgos, Spain) contains an extensive karstic system in which a group of sites covering all of European prehistory is located, from the first settlement of the continent to the end of the Bronze Age. Human fossils have

been recovered from the different sites representing all the known human species that lived in Europe during that time. The oldest fossils (a hand phalanx and a mandibular fragment) come from the deposit of the Sima del Elefante, are dated in around 1.2 My and are attributed to Homo sp. At the TD6 level of the Gran Dolina deposit, more than a hundred human fossils dating from 0.8 My have been recovered and correspond to at least eleven individuals, most of them juveniles. These fossils have been attributed to the new species Homo antecessor and were accumulated in the site due to the first act of cannibalism known in the history of humankind. The Sima de los Huesos site has provided the world's largest collection of Middle Pleistocene human fossils (about 0.43 My) ago. Currently, the collection includes almost 7,000 human fossils from all regions of the skeleton and belonging to a minimum of 28 individuals of both sexes and different ages of death, from early adolescents to fully adult individuals. All the evidence points to the fact that this site documents the earliest evidence of funerary behavior in human evolution. Finally, a foot phalanx attributed to Homo neanderthalensis has been recovered in the site of the Galería de las Estatuas. The excavations continue at all the sites and the research carried out on the different human fossils are contributing new and valuable information on the course of human evolution during the last million years.

S003

The Sima de los Huesos crania and the origin of the Neandertal brain

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The Sima de los Huesos (SH) site is located inside the Cueva Mayor–Cueva del Silo cave system in Sierra de Atapuerca (Burgos, Spain). To date, over 6,600 human fossils from at least 28 individuals are represented in a single stratigraphic level that has been dated to 434 +36/-24 ka. The SH human crania collection includes twenty crania, more or less complete, and up to 1200 isolated cranial fragments. Each field season new bone fragments are discovered which enable more complete reconstructions of the crania. Here we present an updated study based on the latest reconstructions of the SH crania with special attention to Cranium 16 (CR16), a late adolescent, whose upper cranial vault has been further restored, thus enabling a substantially more complete endocranial reconstruction. All SH individuals have been reconstructed using virtual techniques via high-resolution CT scans. Pertaining to cranial general morphology, the new reconstruction of CR16, like other SH individuals, shows a primitive morphology in comparison to its Neanderthal relatives, largely due to being wider in the basal region of the cranial vault; a feature which is also reflected in the endocrania. The SH encephalization quotient (EQ) values have been calculated for SH adults and late adolescents with a mean EQ value of 6.74. The EQ from the SH sample is lower than that of Neanderthals (7.45) and Modern humans (7.31). Therefore, a further increase in the EQ in both Modern Humans and Neanderthals suggests a parallel encephalization process occurred after their last common ancestor. The lower EQ value and the neurocranial morphology in the SH population indicates that in the case of the Neanderthals, the increase in their brain size and the changes in their cranial and endocranial morphologies appeared after the SH population.

S004

Audition and communicative capacities in fossil hominins

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Knowledge of the evolution of the ear is of special interest since it is possible to address two important issues in the field of human evolution. On the one hand, the comparative study of the

structures of the inner ear provides relevant data on the taxonomy and phylogeny of hominins. On the other hand, knowledge of the anatomy and physiology of the outer and middle ear makes it possible to establish the range of frequencies in which different species have their greater auditory acuity and to verify if this region of greatest sensitivity is related to the vocal communication system in our species.

The results of our research on the evolution of the cochlea in the 430 kya fossils from the Sima de los Huesos site (Atapuerca, Spain) show that they had an intermediate anatomy between that of the chimps, on the one hand, and that of modern humans and Neandertals, on the other. Our research has also revealed the existence of a process of parallel evolution in the cochlea between Neandertals and Homo sapiens.

Finally, our studies on the auditory capacities of fossil hominins have shown that the early hominin taxa Australopithecus africanus and Paranthropus robustus had hearing capacities that are more chimp-like, while the hominins of the Sima de los Huesos had clearly different hearing abilities than chimpanzees and were more similar to those of modern humans. These results are consistent with the idea that the anatomical specialization necessary for the correct perception of the sounds on which human language is based is something exclusive of the genus Homo and that these specializations were already present in both the H. sapiens and Neandertal lineages.

Desmosomes in health and disease 1

S005

Structure and function of adhesive contacts

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Intercellular junctions are required for strong adhesion and barrier formation of epithelial cells and allow communication of neighboring cells. Cell-cell contacts comprise adhesive contacts such as desmosomes and adherens junctions (AJ) to provide strong mechanical cohesion, tight junctions (TJ) to seal the intercellular space and thereby to seal the intercellular space as well as gap junctions (GJ) to electrically and metabolically couple cells in tissues. In this symposium, we focus on desmosomes which physically and functionally interact with the other forms of contacts in different cell types. Desmosomes are about 0.5 µm in diameter and consist of two electron-dense plaques, in which adaptor proteins such as plakoglobin and plakophilin (Pkp) via desmoplakin couple the desmosomal cadherins desmoglein (Dsg) and desmocollin (Dsc) to the intermediate filament cytoskeleton. In the intercellular space, the desmosomal cadherins interact in homo- and heterophilic manner, which largely is dependent on Ca2+, at least on the level of single proteins. However, mature desmosomes adopt a Ca2+ – insensitive, so-called hyper-adhesive state, which ultra-structurally can be recognized by a dense midline in the center of the intercellular space. The hyper-adhesive state is positively and negatively regulated by cAMP and PKC signaling, respectively, and in keratinocytes requires Pkp1 and certain cytokeratin isoforms. Desmosomes are most abundant in tissue subjected to high mechanical strain such as the epidermis and heart muscle but are also present in all other epithelia suggesting that desmosomes may be required for strong intercellular adhesion. In addition, desmosomes have been identified to form signaling hubs which regulate cell- and tissue-specific functions such as proliferation, cell migration and wound healing in epithelia or excitation propagation in cardiomyocytes. In this context, it may be important that isoform composition of desmosomal cadherins and intermediate filament components varies in different tissues and also layers of complex epithelia.

S006

The desmosome-keratin complex as a dynamic adhesion structure

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Desmosomal intercellular adhesions and their associated keratin intermediate filaments are hallmarks of epithelial differentiation with profound contributions to epithelial mechanics and function. Crosstalk between desmosomes and keratin filaments determines epithelial plasticity in different functional contexts. Perturbations of this crosstalk result in multiple epithelial diseases.
Investigating the coordination of keratin-desmosome dynamics by time-lapse fluorescence microscopy in cultured reporter cell lines and murine embryos, we were able to identify nascent desmosomes as nucleation sites for elongating keratin filaments. Subsequent keratin filament bundling and desmosome fusion are also coordinated generating a stable transcellular keratin-desmosome scaffold in a "rim-and-spoke" arrangement consisting of interdesmosomal cortical keratin filament bundles (rim) and radial keratin filament bundles connecting desmosomes with the perinuclear keratin cage (spokes). Our observations further suggest that the morphogenesis and maintenance of the keratin-desmosome scaffold is guided by the actin cytoskeleton. In conjunction with keratin- and actin-anchoring hemidesmosomal and focal adhesion sites a scenario emerges, which assigns an important functional role of the keratin-desmosome system for epithelial mechanobiology.

S007

Distribution and Binding Properties of Desmosomal Cadherins in Keratinocytes Lacking Desmosomes

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Desmosomes are complex molecular adhesive structures conferring resistance to tissues exposed to high mechanical stress such as the epidermis. Here we generated HaCaT keratinocyte knockout cell lines deficient for the desmosomal adapter molecule desmoplakin (DP-KO), resulting in complete absence of desmosomes. Intercellular adhesion was more severely compromised in DP-KO compared to plakoglobin KO cells, in which desmosomes, albeit morphologically compromised, were still present. Proliferation, apoptosis and collective migration were not significantly altered in DP-KO. Interestingly, only the protein levels of DSC3 were reduced, whereas other cadherins were largely unaffected. However, the frequency of binding events detected by atomic force microscope (AFM) single molecule force spectroscopy using cantilevers functionalized with DSC3 or DSG3 were not decreased, suggesting that heterophilic interactions with other desmosomal cadherins are more pronounced in DP-KO. In line with this, the localization of both DSC3 and DSG2, which are largely restricted to desmosomes in control cells, changed to a more homogeneous distribution in the membrane of DP-KO. These molecules may serve as additional binding partners probed by AFM. On the free cell surface, an increased amount of membrane tethers was detectable which is in line with lost cytoskeletal anchorage of desmosomal cadherins. However, the forces of individual DSG3 or DSC3-mediated interaction events were unaltered. Together, these data demonstrate that DP is necessary for the stable clustering of desmosomal cadherins but is largely not required for the membrane availability. Furthermore, loss of DP does not alter interaction forces of single desmosomal cadherins. These data indicate that clustering of desmosomal cadherins and their linkage to the cytoskeleton are the primary determinants of desmosomal adhesion in keratinocytes.

S008

Desmosomes in the epidermis and pemphigus pathogenesis

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Keratinocytes are constantly exposed to mechanical stress. Withstanding those forces is crucial to obtain epidermal tissue integrity and thus, dysfunction leads to severe diseases such as pemphigus. Resistance against this mechanical stress is maintained by desmosomes, highly organized protein complexes in which desmosomal cadherins interact with their extracellular domains in a Ca2+-dependent manner. Desmosomal cadherins including desmogleins and desmocollins are intracellularly linked via plaque proteins to the intermediate filament cytoskeleton and isoforms show a differentiation-dependent expression in the epidermis. Thereby, desmosomal cadherins fulfill a broad spectrum of functions in cellular signaling and processes such as wound healing and differentiation.

In pemphigus, autoantibodies directed against desmoglein (Dsg) 1 and 3 lead to compromised desmosomal adhesion in keratinocytes causing blistering of the epidermis and mucous membranes. Mechanisms underlying loss of intercellular adhesion are not fully elucidated and upon autoantibody binding include direct inhibition of Dsg3 interactions as well as Dsg-dependent dysregulation of signaling mechanisms finally causing Dsg depletion from cell membranes and keratin retraction. Central signaling pathways dysregulated in pemphigus, such as p38MAPK and PKC, also modulate Dsg binding properties. Further, keratin retraction is accompanied with redistribution of desmogleins as well as reduced Dsg binding strength. Furthermore, signaling pathways downstream of autoantibody binding seem to also be regulated in Dsg isoform-specific manner. Knowledge on pemphigus pathomechanisms was used to investigate on new therapeutic approaches. For instance, protective cAMP signaling or application of peptides stabilizing desmoglein interactions can abolish autoantibody-induced loss of intercellular adhesion and thus can serve as new therapeutic strategies in pemphigus.

S009

Dsg1 Deficiency Causes Lethal Skin Blistering in Mice

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Pemphigus is a severe autoimmune bullous skin disease caused by autoantibodies which interfere with keratinocyte cohesion and thereby impair epidermal integrity and barrier function. The primary targets of pemphigus autoantibodies are desmosomal cadherins and autoantibodies against desmoglein (Dsg) 1 have been proposed to be required for epidermal blistering. However, since autoantibodies against other targets are detectable in pemphigus patients, the role of Dsg1 for epidermal integrity is not entirely clear. Here, we established a mouse model with a deletion of the complete Dsg1 gene cluster. Lethal skin blistering with superficial cleavage reminiscent of pemphigus foliaceus (PF) histology affected all mice with homozygous deletion of Dsg1, all of which died within 24h after birth. Histology revealed cleavage within the granular layer with complete loss of epidermal tight junctions. In line with this, toluidine dye penetration demonstrated a complete epidermal barrier break-down. These data demonstrate that Dsg1 is pivotal for epidermal integrity and barrier function and loss of Dsg1 causes death due to pemphigus-like epidermal blistering.

Disruptive and Constructive Innovation in Anatomy

S011

Disruptive and Constructive Innovation

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Innovations are desired, they are designed to solve a perceived or real problems. In anatomy, over the past twenty years there has been a surge in innovations linked to anatomical education. At the turn of the millennia CD-ROMs with gross anatomical and embryological content had become standard as a learning resource to use at an institution and at home. With the rise in the internet and the capability of bandwidth and WIFI came the rise of web-based on demand educational platforms. This included 'home grown' material and also the ability to share material through Social Media. At the same time there has also been an increase and development in pedagogical theory as applied to anatomy, such as Near Peer Teaching. At a neuroanatomical level there is also now a greater understanding of how students learn their anatomy. It can be difficult to assess innovations in anatomy, but by applying the framework of Disruptive and Constructive Theory it is possible to evaluate where and how these innovations arose and what they mean to students and educators. The Constructive Theory involves improving the current method and it could be argued that examples would include prosection and Thiel embalming. The Disruptive Theory is based on creating a new market and innovations such as 3D printing, augmented and virtual reality could be argued to be Disruptive. For education the 'new phenomena' exists and as educators we have to ensure we develop sustained high quality evidence as we seek to create and use constructive and disruptive innovations in our practice.

S012

National Neuroanatomy Competition- pedagogy through partnership

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Since 2013, a unique partnership between students, academic staff and clinicians at the University of Southampton led to the development of the National Neuroanatomy Competition, a unique and inspiring event for neurologists and neurosurgeons of the future.

Over the course of 6 years this innovation has expanded to incorporate both an undergraduate and postgraduate competition with over 500 students attending with representation from 32/33 UK medical schools. This project has established a reputation for excellence in the teaching of anatomy and clinical neurosciences, where staff and student partnerships have flourished and led to the transformation of education resources, curriculum strategies and enhancement of the student experience. Nationally these ventures have helped to drive up educational standards during a period when time given to anatomy education is under scrutiny. Furthermore, they promote both the vertical integration of clinical neuroanatomy in medical curricula and serve to raise the profile of neuroscience in medicine more broadly

This initiative has led to the publication of a number of articles that have informed teaching practices in these disciplines and we will discuss the impact the competition has had on the host institution, our previous attendees, winners and on the careers of students who pioneered this enterprise. Performances across a range of subtopics have enabled us to make recommendations to anatomists in areas where educational interventions would be welcomed – a real life example of how we are making original and valuable contributions to pedagogy through partnership.

S013

Exploring the application of extended reality in anatomy education

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In undergraduate medical education, there is a surge of interest in exploring the use of extended

reality such as Virtual Reality (VR) and Augmented Reality (AR) to improve anatomical knowledge. The intention of including these tools, along with cadaveric dissection, is to better enable students to construct a visuospatial representation of the human body and all of its components that can by mentally rotated and regarded from different angles. To contribute to the literature on the use of VR in anatomy education, a collaborative project began to create clinically based VR cases based on different regions in the body for use in a first year anatomy course. The focus of this project is 2-fold: 1) to evaluate the impact 2-D and 3-D technology have on acquisition of anatomical knowledge compared to human specimens, and 2) to identify the perceived workload of learners in these different interventions.

S014

Using eye tracking to investigate learning in the anatomical sciences

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Educators are invested in measuring the progress of their students' learning, yet the assessments we use for this have inherent biases. In recent years various researchers have investigated the use of eye tracking as a tool to objectively document learning, expertise, and misconceptions. Eye tracking, in which the subject's eye movements are measured as they examine and interact with their environment, can give insight into how individuals interact with highly visual content. Experts' gaze patterns focus more quickly and for longer periods of time on salient regions of the visual field, while the gazes of naïve learners move within the visual field more often and more randomly. Numerous studies both within and outside science and medicine have used gaze tracking to investigate the learning process and the gaze behaviour of experts as compared to naïve or less experienced learners. This presentation will review the current state of the literature on this topic and interpret its implications to objectively measure learning, misconceptions, and expertise in our trainees. Ethical approval was not required for this study.

S015

The old and the new: teaching with Thiel and messing with mixed reality

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This presentation will explore two innovations in anatomy that have contributed to the student experience at the University of Dundee. 1. Although anatomy dissection has formed the basis of anatomy learning for a long period, this should not mean that no new ideas can be introduced. The adoption of Thiel soft embalmed cadavers in Dundee has allowed clinical skills that should enhance student anatomy learning to be incorporated into dissection classes. Apart from dissection itself, skills that are useful to medical or dental students have been integrated with dissection to improve understanding, to practise clinical anatomy and to gain a better understanding of individual variation while carrying out the skill. 2. Experiential learning and creation of knowledge are established methods of improving student learning, while employment in the future is more and more likely to involve people with a variety of skill sets working together. Therefore an extra-curricular project was introduced in Dundee that brought together a multidisciplinary student group, academics and industry to create augmented reality anatomy apps. The experience of working together on a common goal with students from other disciplines who have different skills and an unfamiliar vocabulary has given our students a chance to use their anatomical and clinical skills in a completely different environment.

Ethics in anatomical education: the nexus between educator, student, donor and society

S016

Anatomy: a mirror for society and a challenge to normative ethics

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As a discipline, anatomy holds a peculiar position in history and society, and often mirrored the ethical conscience of its time. This is reflected in its earliest and even somewhat dubious beginnings entwined with stories of body snatching and injustices to the most vulnerable such as the poor, and those in legal custody. This paper argues that anatomy, more than any other discipline, has retained this unique position amongst the biomedical sciences as a bearer of society's ethical conscience.

As the advent of the printing press in 17th century heralded a change in the practice of the discipline and the move to adopting a modernistic thought framework, so too the emergence of next-gen technologies like mixed-reality and 3D printing has placed the discipline at the centre of ethical and legal conundrums that reflect the changing post-modern conscience of society. This change in society's thinking emerges in the practice of anatomy and its nexus with other disciplines. Artists, for example, through all of time have used imagery of the human body, dissection, and of anatomical education, to reflect the realities and hopes of the people. In a post-modernistic world, it is no wonder that exhibitions of the human body captivate the general public. As with the public dissections of 16th and 17th century, anatomy again reflects a 'normative' ethic of its time that challenges the role of the anatomists, students, and society leaders.

The paper draws on the discipline's historical perspective and includes a cross-sectional analysis of the attitudes of multiple stakeholders on anatomy exhibitions for public awareness and education, medical training, and post-modern art. The paper posits that the unwritten role of anatomists and of the discipline is to challenge the normative ethic of culture and to contextualise the difficult question society faces: what is good (and who decides).

S017

What are people's "concerns" when contemplating body donation?

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First person donor consent is fundamental in current legislation and regulations governing posthumous body donation in the United Kingdom. To date, most discussions about 'the ethics of body donation' have tended to be primarily 'top-down'; informed mainly by philosophical frameworks or by various experts' proclamations about 'what is important', e.g., patients' autonomy, consent, the integrity and trustworthiness of the donation system, etc. A qualitative study explored with ethical approval from Brighton and Sussex Medical School a range of stakeholder interviews including potential donors to take a different tack by prioritising potential donors' own accounts of their 'interests' and 'concerns'. The results were analysed through Grounded Theory to explore the relationship between themes that showed consistency with existing knowledge that donation seems motivated by a combination of 'altruism' and a belief that cadavers are simply physical matter with no on-going relationship with individuals' 'persons', 'selves', 'spirits', or 'souls'. People's accounts nevertheless reveal important complexity and variation around these main themes. People differ in how they want to be altruistic and towards whom, with one important concern being to balance desires to serve 'the general good' and desires to avoid or reduce distress to specific loved ones. Similarly, people differ in how they conceptualise their dead bodies, from 'just meat' - that anyone can do with what they will - to 'sacred gifts' - that should be used only by particular people in particular ways. These findings highlight several tensions in the notion and practice of first-person donor consent that is fundamental to current legislation and regulations governing posthumous body donation in the United Kingdom.

S018

An Ethical Dilemma: A cross-sectional and longitudinal qualitative study of how donor dissection influences medical students' perceptions of ethics

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Donor dissection as anatomy pedagogy remains debated. While short-term anatomy knowledge gains may not be impacted by dissection, studies suggest that student anxiety levels are. Although donor dissection may impact professional development such as teamwork, studies exploring what else students learn from dissection are limited. A potentially rich lens to explore the role of donors in dissection may be medical ethics. To improve the knowledge base related to anatomy education and medical ethics, we evaluated the longitudinal impacts of donor dissection on medical students' perception of ethics.

Following ethics approval, a longitudinal qualitative study was undertaken at an Australian university where student responses to online discussion forums and interviews were analysed using framework analysis.

Five themes related to ethics in anatomical education were identified: 1. Dignity, 2. Beneficence, 3. Consent, 4. Justification for versus the necessity of dissection and 5. Dichotomy of objectification and personification. The dominant themes of students' ethical perceptions changed with time, with a shift from a focus on aspects of the donor as a person, toward the utility of the donor in anatomy education.

The impact of donor dissection on students' perceptions of ethics is complex. The longitudinal approach presented here suggests a strong impact of donor dissection on priming students' focus on medical ethics, but this changing over time. This research suggests that donor dissection has impacts on students beyond simple anatomical knowledge acquisition and advocates for formal integration of medical ethics with anatomy education.

S019

Body Donation after Medically Assisted Death: An Emerging Consideration for Donor Programs

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The recent legalization and widespread acceptance of medical assistance in dying (MAiD) or euthanasia in numerous jurisdictions has led to an entirely novel and growing supply of bodies for education and research. In our anatomy and surgical skills facility at McMaster University in Ontario, Canada the number of MAiD bodies has grown to 5% of total intake in only two years and we have found that MAID recipients are at least five times more likely to donate their bodies than the general population. The ethical and practical issues of this new stream of bodies need to be considered. The history of the use of euthanized humans in anatomy is truly horrific however the modern incarnation of euthanasia, as a preferred means for terminating one's live when faced with unbearable physical and existential suffering, has little to do with the state-sponsored murder of the past. Numerous questions remain such as are we interfering with the free-choice of the donors by supporting their decision to prematurely end their difficult life to fulfill the higher cause of body donation? Are we putting learners and staff in an impossible ethical position if they disagree with bodies obtained through MAiD? What are the limits of confidentiality when dealing with bodies form MAiD donors? The ethical and practical issues of this new stream of bodies in general, and specifically within the context of Ontario, Canada, will be the subjects of this talk.

S020

Creating a Learning Environment in Anatomy Conducive to the Acquisition of Professional Competencies in Medicine: Experiences at Harvard Medical School

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Anatomy education provides students not only with the opportunity to learn the structure and function of the human body, but also to acquire professional competencies such as teamwork, interpersonal skills, self-awareness, and the ability to reflect on and practice medical ethics. The fulfillment of this wide potential can present a challenge in anatomy courses that are part of an integrated medical curriculum, thus much shorter than traditional courses and in need of additional coordination with other parts of the curriculum. This new reality, together with students' increasing awareness of the stresses within medical education, led to efforts at Harvard Medical School to implement practical steps towards an optimal learning environment in anatomy.

These steps were based on principles described for trauma-informed care: trustworthiness and transparency; peer support; collaboration; empowerment; safety; and cultural, historical, and gender sensitivity. Anatomy is conceptualized as the "first clinical discipline," with relational interactions between anatomical educators, medical students and body donors/patients. Essential prerequisites for the implementation of this work were support by the medical school leadership and motivated students who contributed to team-building exercises, faculty coordination and peer-teaching.

Specific interventions started before the course with a faculty development session addressing course philosophy and a letter to students inviting them to share their thoughts on anatomy. Student responses were discussed during introductory plenary sessions, and students were familiarized with the anatomy course through a pre-dissection lab visit, an introductory guide, and a module on the history and ethics of anatomy. During the ten-week course, team-building activities were scheduled, and self-reflection was encouraged through written exercises, and elective life-body drawing discussion sessions with faculty. Students' responses to these activities varied from neutral to enthusiastic. This first attempt of a systematic implementation of an optimal learning environment in anatomy led to the identification of areas that need adjustment.

S021

The Impact of Digital Technology on Anatomy Education

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Digital technology is influencing how many teaching institutions use bodies donated to science, with medical imaging procedures, photographs, 3D printing, and genomic information all being increasingly utilised with respect to donated human material. This increase in digitisation affects elements of information aquisition and communication that were not previously common concerns, including ease of data sharing, size and type of data bases, authorisation of information transfer, commercialisation of information, and incidental findings arising from exome analysis. At present there is a lack of empirical evidence to guide appropriate utilisation of this digital information including how acquisition, utilisation, distribution, and destruction of such data should take place. The increasing use of digital technology with bodies donated to science raises questions on the nature of informed consent in a digital age, how family involvement in consent processes should be shaped, about anonymity and information sharing, and how potential commercialisation of

data should be addressed. These issues are discussed with respect to how contemporary body donation processes could be adapted to ensure appropriate ethical frameworks are responsive to digital technology. Such adaptations include limitations on the acquisition and distribution of digital material, implentation of governance frameworks specific to genomic analysis, and more specific guidance on consent and commercialisation of digital data arising from bodies donated to science.

Tissue development and regeneration: from biology to engineering

S024

Non-coding RNAs in Tissue Regeneration: From Stem Cell Regulation to Environment Communication

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Human tissue regeneration after injury requires cell activation and cell-cell communication in the microenvironment. Non-coding RNA-mediated post-transcriptional regulatory networks in cells have been proven to be of great significance for cell function regulation, and recent studies have confirmed that stem cells can transfer non-coding RNA between cells through exosomes, which may be a novel way for cell communications. Our group are addressing the non-coding RNA mediated epigenetic regulation of human stem cells self-renewal and found several types of non-coding RNAs, including lincRNAs, microRNAs, and snoRNA, play different roles in stem cell molecular regulatory networks. We also has focused on the exosome-mediated non-coding RNA transferring mechanism from different cell sources and its posttranscriptional regulatory functions in target cells. We recently found that the exosome derived from embryonic stem cells has a special small non-coding RNA component 3A-sdRNA, which can promote the maintenance of embryonic stem cell pluripotency. It can also maintain the population stability of stem cells and contribute to blastocyst development. We also found the therapeutic effect of stem cell-derived exosomes on optic nerve injury through microRNA transfer mechanism. We believe that non-coding RNA may be a precise regulator and molecule signal in either intracellular or intercellular environment. Exosomal non-coding RNAs may be a key message to regulate cell population balance and synergy of cell telebehavior. At the same time, stem cell derived exosomes may be a new therapeutic strategy in stem cell clinical applications.

S025

Complex post-translational modification regulations in spermatogenesis

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Spermatogenesis is a complex developmental process including mitosis of spermatogonia, meiosis of spermatocytes and spermiogenesis of spermatids to finally generate tadpole-shaped sperm. The complex process is under complex protein-level regulations. As shown by single gene studies, protein post-translational modifications, e.g. phosphorylation, ubiquitination and acetylation have been shown to play important regulatory roles.

Prior to sample collection, approval was granted by the ethics committee of Nanjing Medical University. Based on the high-throughput proteomic technologies using modified-peptide enrichment and LC-MS/MS, we profiled post-translational modifications of testicular and sperm proteins, and identified 17829 phosphorylation sites and 13717 ubiquitination sites in mouse testis, and 1206 acetylation sites, 554 N-glycosylation sites and 3303 phosphorylation sites in human sperm. We found complex protein regulatory network, and cross-talk among different modifications in spermatogenesis. Bioinformatics and functional

analysis showed that these modifications play important functions in the spermatogenesis and sperm functions.
The systemic characterization of post-translational modifications during spermatogenesis will provide us rich resources to help further elucidate regulatory mechanisms of spermatogenesis.

S027

Construction of intelligent antithrombotic small diameter tissue engineered blood vessel in vivo

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Thrombosis is one of the biggest obstacles in the clinical application of small-diameter TEBVs. TEBV will lead to platelet aggregation, in which the high concentration of adenosine diphosphate (ADP) that is released by platelets plays an important role. Before endothelializaton of TEBVs in vivo, how to prevent thrombosis is a key start. EPCs homing is key of endothelializaton of TEBVs in vivo. However, excessive or sustained inflammation would reduce the EPCs in blood. So it's critical to promote inflammation resolution of TEBVs in time.
We designed a reduced graphene oxide (RGO) based dual-enzyme biomimetic cascade to successively convert ADP into adenosine monophosphate (AMP) and AMP into adenosine. We modified the surface of the collagen-coated decellularized vascular matrix with the RGO-enzyme complexes, in which RGO functions as a platform with a large open surface area and minimal diffusion barriers for substrates/ products to integrate two catalytic systems for cascading reactions. Then we construted a antithrombotic TEBVs1.
Here we utilized the layer by layer self-assembly nanostructured protein composite biomaterials to withstand blood flow under artery pressure, meanwhile guaranteed capturing endothelial progenitor cells on luminal side, attracting nerve fibers abluminal side and controlled release of location. Based on it, we constructed 1mm netrin-1 TEBVs and they achieved rich innervation at 6 months. The innervated netrin-1 TEBVs remained open for 24 months in rats. TEBV-blocked innervations presented intimal hyperplasia and many of them occluded at 6 months. The degree of nerve reconstruction was positively correlated with long-term endothelialization and normal smooth muscle remodeling of TEBVs. Then 3.5mm pig-derived TEBVs kept patent in canines for 5 months with expression of neuron-specific protein.
We first have constructed a innervated small diameter engineering vascular, which lays the foundation for the realization of tissue engineered blood vessels from autogenousization to functionalization.

Translational research in the anatomical sciences" quo vadis?

S029

Reverse translational research in anatomy: examples of direct clinical impact from anatomical feasibility studies

Shane Tubbs[1]
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Anatomy is a key component of medical knowledge. However, all too often, research in the anatomical sciences has difficulty bridging the gap between study findings and actual patient impact. Therefore, the concept of translational research in the anatomical sciences is important for maintaining the relevance of anatomy in a modern world and in understanding the best ways of maximizing the influence of anatomical studies for patient care. The speaker will discuss reverse translational research in anatomy with examples of direct clinical impact from published anatomical feasibility studies.

S030

Bridging the gap between medical need and anatomical study

Robert Jay Spinner[1]
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Times are changing. Classically trained clinicians and anatomists are each siloed. Clinical anatomists can bridge the gap between medical need and anatomical study. Medical schools need to recognize the potential for interdisciplinary collaboration in anatomy: in education, clinical practice, research and administration. By establishing Departments of Clinical Anatomy (rather than Departments of Anatomy), we can be disruptive. A simple name change recognizes the importance to translate and innovate in anatomy and medicine: whether through surgical simulation (including microsurgery), 3D printing, augmented reality or postgraduate Continuing Medical Education courses. This next generation of clinical anatomists will possess new skills and enjoy added opportunities in teaching and training learners at all stages and across health care disciplines, conduct translational research, gain leadership skills, and monetarize -- that can not only change, but transform health care in the near future.

S031

How to publish your clinically related anatomical research

Stephen Carmichael[1]
[1]*Mayo Clinic, Rochester, United States*

Publishing clinically related translational research may be a new path for some anatomists. Certain approaches used to publish “bench” research need to be modified when publishing novel clinically relevant research. This presentation will discuss several relevant questions. What makes your clinical research “novel”? How can you best ensure that your manuscript is appropriate for the journal to which you are submitting it and conforms to the format of the journal? What guidelines should you use in recommending reviewers for your paper, or specifically excluding certain reviewers? How do you properly address the use of human specimens in your research and ensure that you are complying with all appropriate regulations? It is the intention of this presentation to help guide nascent clinical anatomists publishing their research.

S032

Translational and Reverse Translational Research in Anatomical Sciences

Marios Loukas[1]
[1]*St. George's University, St. George, Grenada*

Basic sciences and specifically anatomical sciences are key components of medical knowledge for medical students and physicians. Although anatomical sciences and specifically gross anatomy is essential to medical knowledge, gross anatomy research has proven difficult to directly have an impact on actual patient care. As a result, the concept of translational research has been introduced to address the gap between gross anatomy and patient care. This talk will provide cases from published studies using gross anatomy as the basis for conducting translational research and its direct impact on patient care. Furthermore, this talk will provide examples of research in the areas of clinical anatomy research, translational research, reverse translational research and the impact on patient care. Finally, this talk will provide concrete examples of future projects of anatomical feasibility studies and potential directions for new studies. All studies presented have been approved by IRB.

S033

How to go from full-time clinician to full-time anatomical researcher

Joe Iwanaga[1]
[1]*Seattle Science Foundation, Seattle, United States*

The purpose of clinical anatomy research is to provide better "patient care." Hundreds of years ago, most professors of anatomy were also professors of surgery. As time passed, anatomists and surgeons became completely separate disciplines and since, have rarely joined hands. Regardless both anatomists and surgeons probably realize that they must reunite in order to develop surgical/clinical anatomy. From a clinical point of view, better surgery and clinical diagnosis necessitate a deeper need for anatomical knowledge. Occasionally, this need encourages clinicians to revisit anatomy. Anatomy research driven by clinical questions can develop novel ideas which correlate closely with patient care such as new surgical techniques, new surgical devices, and excellent education tools. The speaker will discuss his career as a clinician and as an anatomical researcher and how this combination has generated novel clinical anatomy studies bringing together both clinicians and anatomists.

Anatomy: its role in internationalisation of higher education and its contribution to the knowledge society

S034

Anatomy, challenges and rewards to internationalisation

Nalini Pather[1], Quentin Fogg[2]
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The presentation focusses on the role of anatomy in the internationalisation of higher education and demonstrates the challenges and rewards through two lenses: i. the discipline of anatomy as an enabler a knowledge society, and ii. the anatomist in the undergraduate, graduate and vocational worlds

i. Anatomy: an enabler of the knowledge society: Technology has presented new and diverse ways in which knowledge is both produced and disseminated and has created a knowledge-based society and economy. Knowledge has become dynamic, present and real in everything that we do. This talk will highlight that anatomists have embraced the concept of a knowledge society, and that internationalisation of higher education has broken geographical boundaries that has allowed the creation and sharing of new knowledge that extends beyond the confines of the discipline. Anatomy is well-positioned in this technological age to further embrace the internationalisation of higher education levering strategic global collaboration to continually create non-linear two-way networked relationships that advances education, capacity building and thus generating value for global society. This presentation uses the case-study of a collaboration between Chinese Universities and UNSW Sydney to develop staff-capacity to illustrate the development of the knowledge society.

ii. The anatomist in undergraduate, graduate and vocational worlds: challenges and rewards of providing education internationally - Anatomy in an international context presents itself in many forms. It may be through the provision of customised education for visiting students, teaching at an "off-shore" institution where the students felt hindered in their perception and opportunities clinically, or delivery short courses to students from vastly different backgrounds. These challenges, and the unique opportunities they afford, will be presented. This talk aims to make you think of yourself internationally, put you in the shoes of a diverse array of learners, and celebrate the eye-opening experiences working around the globe offers.

S035

Internationalisation of education: what do we mean and why is it important?

Helen Nicholson[1]
[1]*University Of Otago, Dunedin, New Zealand*

Internationalisation is an important component of 21st century education, but internationalisation of education is interpreted in many ways. From a governmental or a university's senior management perspective it is often restricted to increasing international student recruitment and financial income. However, internationalisation is broader than this and should be aiming to develop understanding that will allow our students, both domestic and international, and staff to live and work globally. Anatomy as a discipline is well placed with a common terminology to embrace internationalisation. As an international community access to resources, be they cadavers, technology or teachers, is not evenly distributed. What responsibilities do those of us in well-resourced institutions have to our fellow anatomists? This talk will explore the complexities of internationalisation with relation to the curriculum, student and staff mobility and engagement. It will discuss how developing sustainable partnerships with overseas universities for teaching and research assists in preparing our students and staff to be global citizens.

S036

Brain drain, brain gain: Building bridges in anatomical research across continents

Beverley Kramer

Scientific collaborations between the developed and developing worlds provide opportunities to expand intellectual discourse and professional networks and mitigate the enormous 'brain drain' that has occurred in some continents. Additionally, growing robust research institutions and increasing skills in developing countries is critical to alleviate current disease burdens. The University of the Witwatersrand (Wits), South Africa has, over time, lost significant numbers of its health sciences graduates to other countries due to political and social instability. Many of these graduands have become leaders in their research fields in the countries to which they have migrated. In 2010, the Faculty of Health Sciences at Wits, initiated an Alumni Diaspora Programme. The Programme was designed to boost international research collaborations and networking between leading health sciences alumni who live and work at academic institutions abroad and their counterparts "back home" at Wits. This, in effect, would build bridges between the developed world and the developing world that would accelerate the production of, and strengthen the next generation of health sciences researchers at Wits.

Over the period 2010-2019, numerous alumni have returned to the Wits Faculty of Health Sciences to develop collaborations with their Hosts in research, capacity and skills development. In addition to alumni carrying out research into HIV, TB, malaria and diseases of lifestyle, the Programme has also included a number of anatomists. These anatomists are now collaborating with individuals in both the School of Anatomical Sciences and the Unit for Undergraduate Medical Education at Wits. The "gains" of these collaborations, both tangible and intangible, have contributed to development of research, not only at Wits, but also at the alumna/us' participating institution. The Programme has added to skills training, knowledge production and knowledge sharing on both sides of the bridge.

The Programme is funded by the Carnegie Organisation of New York.

S037

Delivering the same Anatomy Curriculum in two different Asia-Pacific countries: the Malaysian perspective

Lakshmi Selvaratnam[1]

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Monash University has its principal base in Melbourne, Australia but operates campuses in Malaysia, India, South Africa and Italy. Of particular interest is the undergraduate medical degree delivered simultaneously in Melbourne

and in Bandar Sunway, Malaysia, and accredited by the Australian Medical Council. Uniquely, students at both campuses follow the same curriculum with the same learning outcomes and sit the same exams, despite local contextualisation for healthcare issues and community practices and differing resources, particularly in anatomy. As a result, different delivery systems for anatomy teaching and learning have had to evolve on the Malaysian campus, some of which have been innovative and award-winning. This talk will address how these differences are used positively and explore the challenges and benefits of this arrangement, especially from the Malaysian campus perspective over the last 12 years.
(Ethical approval was not required)

S038

Collaborative Development of Anatomy Workshops for Medical, Dental, Nursing and Midwifery Students in Cambodia

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Anatomy programs in many modern developed countries include significant time spent in practical classes studying anatomy with prosected material, dissection, anatomical models, X-ray films, CT and MRI scans, and other innovative resources. However, these resources are not readily available in many in developing countries. In Cambodia, the problem is further compounded by historical loss of staff and teaching resources and has resulted in significant challenges to anatomy education. Over the last 10 years, we have developed and implemented a series of anatomical workshops for medicine, dentistry, nursing and midwifery students in Cambodia. The first series of workshops, delivered in 2010, was designed to implement a fully resourced and sustainable program for anatomy students. A five-point Likert scale questionnaire was used to evaluate student satisfaction. Cambodian students almost always agreed with positive statements regarding the value of the workshops, and also regarding the utility of the specific resources (photographs/images, models, body-painting). However, continuation of the workshop program was limited by availability of local teaching staff. A second series of workshops, delivered in 2015, was designed to demonstrate that anatomy workshops could be implemented despite low staff numbers, through the use of peer tutoring. Evaluations showed that almost all Cambodian medical students who acted as peer tutors agreed that peer tutoring increased their anatomical knowledge and confidence, and that the overwhelming majority of Cambodian nursing students who received peer tutoring agreed with statements that they would like peer tutoring to continue and that they would like to be peer tutors themselves. This demonstrates that peer tutoring could be an effective tool in educational settings where poor staff-to-student ratios limit delivery of anatomy workshops. Our collaboration has provided leadership and training opportunities for anatomy teachers from Australia, and for local staff and students/peer tutors in Cambodia.

S039

Clinical anatomy in Australia and India: What we can learn from each other

Ian Johnson[1]
[1]Macquarie University, Sydney, Australia

Internationalisation is widely promoted in tertiary education as it enables both students and academics to gain a broader perspective on their subject and its place in the world, and thereby promote transformative learning. Because of this, it is actively promoted at Macquarie

University, which is placed 18th amongst the most international universities in the world in The Times Higher Education Rankings. This presentation will explore the benefits and challenges of the internationalisation of clinical anatomy teaching by reflecting on two strategic initiatives. The first is the 4-year Macquarie MD which includes 21 weeks placement in year 3 at the Apollo Hospital, Hyderabad, and up to 16 weeks compulsory international learning experiences in year 4. The second is my visiting professorship in Anatomy at the Sri Ramachandra Medical College, Chennai, India and my continuing links with the University of Adelaide, Australia. Benefits of these relationships are that they have provided educational experiences that would be impossible in the home countries, they have promoted the exchange of educational approaches and innovations between the universities, they have highlighted cultural differences in educational approaches that are variously perceived as impediments or beneficial, they have promoted the exchange of technical expertise in embalming procedures and novel methods of tissue analysis, and they have facilitated international links between our Clinical Anatomy Associations. Challenges include adapting to different cultures and infrastructures by both students and staff, the logistics of arranging student visits and effective academic cover during periods of absence from our home institutions and finding funds for the visits. Overall, the greatest benefit has been the opportunity for procedures and practices to be viewed from different perspectives.
Ethical approval was not required

S040

The anatomy of a partnership: challenges and perks

Carol Hartmann[1], Nalini Pather[2]
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Higher education has become an integral part of academic globalisation. It not only presents opportunities to enhance academic offerings to student cohorts, but assists in cross-border skills exchange, knowledge sharing and matching supply and demand. Higher education can no longer be viewed strictly as national endeavours with narrow agendas. However, international collaborations and research partnerships can be daunting and difficult to navigate. This presentation uses a exemplar of a three- year formal collaboration between UNSW Sydney, Australia, and the University of the Witwatersrand, South Africa, to highlight the benefits and challenges of collaborating with partners across the globe for education innovation and academic development and support. It will present an overview of establishing a collaboration, tips on communicating when space, time and culture presents challenges as well as how to develop research proposals that meet the diverse requirements of institutional committees. Negotiating the expectations of a research collaboration between primary participants as well as institutional collaborators while balancing life and work will also be discussed. Underpinning this, is a discussion of the meaning of internationalisation, a description of the rationale for and approaches to internationalisation, and an analysis of strategies of integrating international dimensions in a higher education institution.

S041

BEST Network – Creating, collaborating and sharing anatomy education resources internationally

Nicholas Hawkins[1], Stephanie Dowdell[1], Nalini Pather[1]
[1]UNSW Sydney, Kensington, Australia

Online education resources and technologies play a large role in today's learning and are one solution to improving educational equality. Teaching anatomy relies on the use of cadavers, bones, models and x-rays, and their digital counterparts are important for online education. Yet creating or accessing resources for online or blended learning is time-consuming, and

unsurprisingly access to these materials differs between institutions.

The BEST Network (best.edu.au) was created to help individual academics solve this important problem of resource access, by letting them internationalise their teaching resources. As a collaboration of thousands of academics, BEST operates on the strategy that by working together we can contribute more effectively to the knowledge society. Using shared tools, biomedical images and resources are transformed into interactive and engaging online teaching materials. Sharing these resources with the community allows them to be used by students locally, nationally and internationally. The network aims to reduce duplication of resources and technologies across institutions, benefiting from the economies of scale that come from developing, maintaining and growing a collection of resources on a single platform.

Anatomists have been integral in establishing our collaborative educational economy. Members have created and shared thousands of images and over 250 online tutorials, over a third of these covering anatomy-related topics. These lessons are adapted by hundreds of academics each year for use by their students. The nature of the BEST Network platform means academics can easily create new content or use and alter the shared collection to ensure local relevance.

This presentation will cover the establishment of an online community of practice as well as the measurable impact that individual academics can have on the internationalisation of anatomy education. Ethical approval has been provided for the collection of biomedical images and surveying students.

Barriers bugs and bandages

S042

Getting Skin in the Game: A lesson on the structure and function of the body's innate physical barriers using open educational resources

Jamie Chapman[1], Nathan Swailes[2]

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The concept of a physical barrier in the human body is foundational to understanding the pathogenesis of disease. The human body's first line of defense is its natural coverings forming a contiguous barrier that employ various strategies to combat external threats from foreign substances and pathogenic microorganisms. The integrity and normal function of these barriers is therefore paramount for health and when they fail, are damaged or disrupted, it underpins many diseases. These barriers are constructed from some of the body's most basic of tissues: epithelia and their underlying connective tissues. It is therefore important for medical, dental and allied health students to understand how these cells and tissues are assembled to carry out their essential physiological functions.

The skin, for example, has numerous strategies to form a protective barrier – its surface epidermis is stratified, with its keratinocytes held together by numerous cell junctions to maintain integrity; its surface contains several layers of dead keratinocytes (corneocytes) to combat abrasion; dying keratinocytes within the granular layer release lamellar bodies that contain waterproofing lipids and antimicrobial peptides that surround corneocytes; resident antigen-presenting dendritic cells form a network within the epidermis to trap invading microbes. Within loose connective tissue of the papillary dermis, resident mast cells may release mediators to initiate inflammatory responses, attracting other immune cells to the site of infection.

For many, obtaining access to the educational resources to teach this functional histology can be difficult. Not only locating them, but also finding examples that are engaging, can be adapted and/or sit on a platform that is readily accessible to students. During this session you will see some of the resources that we have created and use in our own teaching (Virtual Microscopy; YouTube channels; Twitter threads and Instagram quizzes) that are freely available to support academics and students alike.

S043

Regulation of Inflammation in Normal and Impaired Cutaneous Wound Healing

Kimberly Mace[1]
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Inflammation is a hallmark of healing in a plethora of tissues, including skin, and is associated with an acute active phase followed by resolving phase that is tightly regulated. Deregulation of this process is associated with ageing and diseases such as diabetes. In these pathological environments, skin wounds are characterised by excessive myeloid cells that display an aberrant phenotype, and fail to resolve inflammatory responses in a timely manner, thus impeding wound healing. We found that the aberrant myeloid cell phenotype is partially mediated by stable intrinsic changes induced during haematopoietic development. We have investigated how these intrinsic changes contribute to chronic inflammation and have identified specific signalling pathways, such as TLR and JAK/STAT, that directly contribute to chronic inflammation. Moreover, we have identified specific genes targeted by these pathways that can be manipulated to ameliorate chronic inflammation in diabetic wounds. Mechanisms underlying these changes include pre-priming of myeloid cells in the bone marrow in a training phase, followed by a tolerance-like phenotype in the periphery, leading to diminished acute response, prolonged inflammation and poor healing outcomes. These data will have impact on development of potential therapeutic targets in chronic wounds and other chronic inflammatory diseases.
All animal experiments performed in this study were approved by the University of Manchester local ethical review committee as well as the UK Home Office (Project Licence #70/8136). Mice were wounded on the dorsum under general anaesthesia and provided with analgesics at the time of surgery. Mice were killed using an ASPA approved humane method (exposure to rising concentration of CO2 and cervical dislocation) at defined endpoints. All procedures involving human peripheral blood were approved by the UK Northwest Research Ethics Committee (reference 16/YH/0415), NHS HRA, and NHS R&D (IRAS project ID 188513). Informed consent was obtained from all participants prior to blood collection.

Desmosomes in health and disease 2

S045

Desmosomes in cardiomyocytes and Arrhythmogenic cardiomyopathy

Jens Waschke[1]
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The talk addresses the mechanisms by which cell cohesion and excitation propagation in cardiomyocytes can be modulated. Cardiomyocytes are coupled mechanically and electrically via intercalated discs, which are complex intercellular adhesive structures consisting of desmosomes, adherens junctions and gap junctions. We found that adrenergic signaling enhances cardiomyocyte cohesion and Dsg2 adhesion as measured by atomic force microscopy (AFM) at least in part via PKA-mediated phosphorylation of the intercalated disc plaque protein plakoglobin. We refer to this mechanism as positive adhesiotropy. Since an inhibitory peptide against Dsg2 reduced heart rate in Langendorff-perfused murine hearts and inhibition of Dsg2 adhesion or depletion of Dsg2 and Pg induced arrhythmia in cultured cardiomyocytes, these data support the notion that desmosomal adhesion is required for excitation propagation. This view is also supported by the clinical phenotype of the rare genetic heart disease Arrhythmogenic cardiomyopathy (AC), in which mutations of desmosomal components of the intercalated discs cause sudden cardiac death. Therefore, we hypothesize that modulation of cardiomyocyte cohesion is efficient to regulate excitation

propagation and to treat arrhythmia in AC. Recent data using a tandem peptide designed to cross-link desmosomal cadherins support this idea.

S046

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The desmosomal cadherins desmoglein 2 and desmocollin 2 are the predominant transmembrane proteins of desmosomes in simple epithelia and the heart muscle. Particular attention has been paid to mutations in the desmoglein 2-encoding gene. They are frequently observed in arrhythmogenic cardiomyopathy (AC). The recent identification of desmoglein 2 autoantibodies in the serum of the vast majority of AC patients further highlights the crucial pathogenic function of this cadherin in AC.
To investigate aspects of AC pathogenesis, we have generated multiple transgenic mouse lines, which carry different desmoglein 2 mutations. These mice develop an AC-like phenotype. One of the earliest alterations occurring prior to the development of the overt disease phenotype is an increased expression of skeletal muscle actin which is exacerbated during disease progression, especially in regions close to cardiac replacement fibrosis. Immunostainings suggest that it accumulates in the terminal junction next to the intercalated disc. We accrued evidence that the ectopic actin expression is caused by mechanical stress and TGFβ expression through activation of the serum response factor (SRF) signaling pathway. Prior to fibrotic lesion formation SRF-activation appears to be TGFβ independent and relies on mechanical SRF-activation. During lesion formation and in the presence of mature fibrotic lesions, SRF-activation is further increased by TGFβ that is synthesized in stressed cardiomyocytes and cells within the fibrotic foci
Taken together, our findings suggest that mutations and antibody-induced targeting of desmoglein 2 both compromise cardiomyocyte adhesion as a first step in AC pathogenesis.

S048

Desmoglein2 (DSG2)-mediated adhesion and signalling regulate intestinal epithelial barrier function in health and disease

Nicolas Schlegel[1]
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Maintenance of intestinal epithelial barrier function is pivotal to protect the organism against pathogens present in the gut lumen. In inflammatory bowel diseases loss of intestinal epithelial barrier function significantly contributes to the severe clinical phenotype which makes stabilization of intestinal barrier function an important therapeutic target. However, the mechanisms regulating intestinal barrier function are not completely understood. Increasing evidence points to a critical role of desmosomal integrity which requires DSG2-mediated adhesion and signalling to regulate the intestinal barrier.
It has been demonstrated that the presence of DSG2 contributes to the maturation and to the maintenance of the intestinal barrier. Furthermore it has been shown that proinflammatory cytokines lead to a reduction of DSG2 at the cell borders which is associated with a loss of tight junction protein claudin1 and an increase of pore-forming claudin2. Mice deficient for DSG2 in the intestine are highly susceptible to inflammatory stimuli. In line with this we have observed that DSG2 is reduced in patients suffering from inflammatory bowel diseases. Detailed analyses on the mechanisms of DSG2-mediated intestinal barrier regulation provide evidence that DSG2 is not confined to mechanical stabilization of intercellular adhesion. Rather it was shown that DSG2 also regulates p38MAPK and modulates EGF receptor signalling. Furthermore recent data indicate that claudin2 expression is regulated by DSG2 which sequesters PI3-kinase at the cell borders under basal conditions. The neurotrophic factor Glial cell line-derived neurotrophic factor (GDNF) which is required for intestinal barrier maturation in vitro and in vivo acts via stabilization of DSG2 by modulating cytokeratin phosphorylation.

In summary, DSG2-dependent adhesion and signalling is critically involved in intestinal barrier regulation in health and disease. This makes DSG2 an interesting target to further develop specific therapies to stabilize intestinal epithelial barrier function.

Sectional and imaging anatomy based on multimodal data

S050

Brain structure differences between Chinese and Caucasian cohorts: a morphometry study

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Numerous behavioral observations and brain function studies have demonstrated that neurological differences exist between East Asians and Westerners. However, the extent to which these factors relate to differences in brain structure is still not clear. The anatomical differences in brain structure play a primary and critical role in the origination of functional and behavior differences. To investigate the underlying differences in brain structure between the two cultural/ethnic groups, we conducted a comparative study on education-matched right-handed young male adults (age=22-29years) from two cohorts, Han Chinese (n=45) and Caucasians (n=45), using high-dimensional structural magnetic resonance imaging (MRI) data. Using two well-validated imaging analysis techniques, surface-based morphometry (SBM) and voxel-based morphometry (VBM), we performed a comprehensive vertex-wise morphometric analysis of the brain structures between Chinese and Caucasian cohorts. We identified consistent significant between-group differences in cortical thickness, volume and surface area in the frontal, temporal, parietal, occipital, and insular lobes as well as the cingulate cortices. And the Chinese and Caucasian people have different brain asymmetry patterns. Our findings systematically revealed comprehensive brain structural differences between young male Chinese and Caucasians, and provided new neuroanatomical insights to the behavioral and functional distinctions in the two cultural/ethnic populations.

S051

Human Brainnetome Atlas and its Applications

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The human brain atlases that allow correlating brain anatomy with psychological and cognitive functions are in transition from ex vivo histology-based printed atlases to digital brain maps providing multimodal in vivo information. Many current human brain atlases cover only specific structures, lack fine-grained parcellations, and fail to provide functionally important connectivity information. Using noninvasive multimodal neuroimaging techniques, we designed a connectivity-based parcellation framework that identifies the subdivisions of the entire human brain, revealing the in vivo connectivity architecture. The resulting human Brainnetome Atlas contains 210 cortical, 36 subcortical subregions and information on both anatomical and functional connections. It provides not only fine-grained subregions based on structural connectivity patterns but complements these by detailed functional connectivity patterns for each area. It will facilitate investigations of structure-function relationships, comparative neuroanatomical studies, and promises new biomarkers for diagnosis and clinical studies.

S053

Multivariate classification analysis on the depressive disorders using connectivity measures

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Diagnosis of major depressive disorder (MDD) using resting-state functional magnetic resonance imaging (fMRI) data faces many challenges due to the high dimensionality, small samples, noisy and individual variability. The contribution of the connection measures remains unclear in the classification of MDD patients and healthy controls. In this study, we performed a data-driving classification analysis using the whole-brain connectivity measures which included the functional connectivity from two templates and effective connectivity measures created by the default mode network (DMN), dorsal attention network (DAN), frontal-parietal network (FPN), and silence network (SN). Effective connectivity measures were extracted using spectral Dynamic Causal Modeling (spDCM). Linear Support Vector Machine (linear SVM), non-linear SVM, k-Nearest Neighbor (KNN), and Logistic Regression (LR) were used as the classifiers to identify the differences between MDD patients and healthy controls. Our results showed that the highest accuracy achieved 91.67% ($p < 0.0001$) when using 19 effective connections and 89.36% when using 6,650 functional connections. The functional connections with high discriminative power were mainly located within or across the whole brain resting-state networks while the discriminative effective connections located in several specific regions, such as posterior cingulate cortex (PCC), ventromedial prefrontal cortex (vmPFC), dorsal cingulate cortex (dACC), and inferior parietal lobes (IPL). Our study demonstrated that the effective connectivity measure played a more important role than the functional connectivity in exploring the alterations between patients and health controls. Moreover, our results showed a diagnostic potential of the effective connectivity for the diagnosis of MDD patients with high accuracies allowing for earlier prevention or intervention. The experiments were performed with the understanding and consent of the subject.

Anatomical sciences: a nexus for integrating medical education with the humanities and promoting humanism

S057

The role of history and ethics of anatomy in the development of professional competencies in medicine

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While time spent on anatomical education in medical school curricula has been diminishing over the last decades, the recognized role of anatomical dissection has expanded. It is perceived by many students and faculty not only as the means of learning the structure and function of the human body, but also as an opportunity for the acquisition of professional competencies such as team work, patient–doctor interaction, medical epistemology, self-awareness and through all this an understanding of medical ethics. It is proposed here that this learning process can be supported effectively through studying examples from the history of anatomy, as insights from this history can shine a clear light on present ethical issues in anatomy and medicine. Anatomical education can thus provide not only the opportunity of gaining awareness of ethical questions, but also a chance to practice these new insights within the protected environment of the laboratories, in interaction with the dead and the living. Consequently, a new role has developed for anatomists, which includes the interweaving of the scholarly exploration of the history and ethics of anatomy with the practical application of research results into a

reframed concept of anatomical education. Anatomy, as a foundational discipline in the medical curriculum, can thus provide a first step on the educational path of empathetic and humane medical caregivers.

S058

Anatomy, a nexus for the humanities: A trend towards embedding philosophy and reason into the anatomical sciences

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Anatomy presents a unique opportunity in medical programs to integrate philosophy by maximising the discipline's natural links with ethical, social and conceptual problems arising in medical practice. The practice of the discipline of anatomy with a medical humanities backdrop provides context to explore an important and relevant ontological question: what constitutes a human being. Besides death and dying, suffering and personhood, the practice of anatomy relates to informed consent, confidentiality, competency, resources, and the natural encounter with the 'first patient'. Anatomical teaching, including in the sub-disciplines of histology and embryology, can provide the distinct opportunity to engage medical students in developing as better physicians by developing philosophical skills and attitudes to evaluate self, assumptions and biases, broaden perspectives, gain knowledge, develop critical thinking and a sense of tolerance and awareness of diversity and distress. With this appreciation of humanity, and being humane, a medical doctor is equipped to not only understand the patient as a person but to proactively care for patient wellbeing. As distress and empathy are bed-fellows to the notion of wellbeing, the discipline is ideally positioned to commence discussions with medical students on personal wellbeing essential for medical practice. This paper will discuss the areas in each of the anatomical sub-disciplines that present a natural connection with this philosophical framework, provide examples of how these can be embedded in each of the sub-disciplines of the anatomical sciences, and evaluate the impact of this in light of current trends in medical education.

S059

Memorials for body donors and their role in anatomy education: objects, places and digital spaces

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Acknowledging the importance of body donation and paying respect to donors has become one of the noteworthy features of modern anatomy education. Among the several ways in which medical schools worldwide honour body donors is the establishment of apposite monuments or memorial spaces, including those in the digital sphere. This presentation provides an overview of existing anatomy memorials and their reception among some of the major stakeholders in anatomy education. The memorials for body donors vary in their format across different academic and cultural milieus. They range from remembrance plaques to memorial parks and interactive web sites. The anatomy memorials often are, or contain, works of art, which appear to be the ideal media to convey their humane and humanistic messages. They express gratitude of anatomy professionals and their students to the donors and their families and facilitate reflection about the significance of donation. In an educational context, the presence of memorials and their integration into anatomy curricula provide an opportunity for development of non-traditional discipline independent skills, such as professionalism and medical ethics. Research on how these memorials are perceived by major stakeholders in anatomy education and the wider community is still in its infancy. However, several studies conducted so far suggest that the role of anatomy memorials is highly valued by both donors' family members and students. Where present, anatomy memorials seem to play a significant role in medical education and

establishment of trustworthy relationships with the wider community.

S060

The Role of Body Donation Programs in Developing Ethics and Promoting Humanism

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Due to the growing need for bodies for teaching purposes, several Universities have created voluntary donation-based body acquisition programs. However, these programs may have a role that goes beyond just acquiring bodies. The body donation programs (BDP) might be a potential tool to apply in medical education. Undergraduate students can get involved in campaigns to spread amongst the population the living voluntary body donation program. Besides that, the increasing number of acquired bodies provided the possibility to create different linked activities as the Dissection Workshop, the Museum of Anatomy and the Ceremony to Honor the Body Donors. At the Dissection Workshop students are offered the opportunity to improve their technical and scientific abilities. Simultaneously they increase their awareness of issues related to the need and the importance of living donating bodies, in order to continue such activities. In additional way the students in the first year of the medical course can get involved with the Ceremony. This fact encourages reflection on ethical issues, in order to modify paradigms by raising awareness, and increasing responsibility and dedication to learning. The Museum of Anatomy has an important role in offering opportunity to students share their knowledge with the community in the form of education and art. The PDC might promote the involvement of the undergraduate students, both as scholarship holders or volunteers, working to improve the organization and implementation of the program as well as being participants in the activities and courses. These activities can provide a range of opportunities for students to reflect on ethical and humanistic aspects during their academic training.

S061

From the Clinic to the Classroom: A translational approach for integrating non-technical discipline independent skills in an anatomy curriculum

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Physician education is a longitudinal continuum that is built on sets of foundational skills, demonstrated through physician competency and success within the health care environment. It requires both technical and non-technical discipline independent skills (NTDIS) that when initiated early in the medical curriculum, helps reduce uncertainty in future practice setting. By design, team-based anatomy curricula that offer a laboratory component provide inherent opportunity for development of NTDIS through evaluated student centered activities. Assessment of NTDIS when directed through formative feedback with additional written and verbal feedback has been shown to have greater impact on student outcome. Clinical competencies during residency training can be translated into first-year medical school anatomy course objectives for NTDIS within an authentic curriculum approach. Using current curricular practice, key course activities will be highlighted through a series of quality improvement research projects to demonstrate synergy between the emphasis of NTDIS in anatomy and residency curricula. Anatomy dissection laboratory is not an emotionally neutral environment, therefor it promotes development of professional values, reflective practice, teamwork, and professional socialization of incoming medical students from diverse backgrounds. Anatomy educators are well positioned to guide this process which clearly initiates process of professional identity formation (PIF) among students.

S062

From old marriage to contemporary partnership: the changing relationship between anatomy and the visual arts.

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With the alarming decline of creative thinking amongst university students, educators should find ways to encourage the development of skills that support creativity in our students. Anatomy and the visual arts have shared a close relationship for centuries. The re-invigoration of this relationship in a contemporary, integrated context provides unique learning opportunities for students to develop valuable 21st century graduate skills. In such a collaborative teaching environment, not only do students have an opportunity to gain knowledge and visual comprehension of the structures that compose the human body but are posited in a collaborative interdisciplinary space that empowers them to be creative thinkers.

S063

Humanities in the humour of anatomy comic strips

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The presenter has been drawing the anatomy comic strip entitled “Dr. Anatophil” since 2000. As a result, a large freely-available collection, in excess of 100 comic strips, are available in English from the webpage anatomy.co.kr. All episodes can be used in lecture presentations or on other educational resources with no restriction. The first intention of the comic strips was to help students memorize anatomy by providing related mnemonics. The second intention was to help students enjoy anatomy by providing related humour. The humour is based on humanities and a humane approach that is prevalent in anatomy class. For example, dissection tools such as the scalpel blade made the students behave gently to one another because of the tools’ inherent danger. For another example, in the spirit "one for all", a high-achieving student dissects the cadaver skilfully and uses this to demonstrate anatomy to other students. In the spirit "all for one", students kindly explain the cadaver dissection to a student who is lagging behind. The humane attitude contained in this humour engages comradeship among students that is additionally gained during dissection. The comic strips could be a tool to remind the students of the humanities. Further, the comic strips may be used as a material, through which the anatomists discuss the role of humanities and importance of humanism.

S064

An Anatomical Whodunnit? - Dissecting the Rothschild Bronzes - Michelangelo a Sculptor in Bronze

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Two nude male figures riding panthers exhibited at the Fitzwilliam Museum in Cambridge have been dated by Prof. Joannides - Professor of Art History at Cambridge, the Rijksmuseum, Holland and other bronze experts to the years 1506-1508. As a clinical anatomist I was approached to give an opinion on the detailed anatomical structures that are revealed - which I would like to share with you, following some 3 years of very close examination of these nudes. The accuracy in proportion and position of detailed musculature is uncanny and the sculptor’s passion for the human body shines through every aspect of the bronzes resulting in a “hyper-anatomised “male beauty, in all its anatomical accuracy. The academic world of art has concluded with my anatomical studies that Michelangelo is the probable sculptor, and this has resulted in the publication of a multi-disciplinary book on “Michelangelo - Sculptor in Bronze” Published by Cambridge university press. Dr Eike Schmidt –

Director of the Uffizi Gallery in Florence says of the book “This is a game changer as it provides a completely new integrated interdisciplinary approach to Michelangelo studies with experts from anatomy, art history, conservation science and technical archaeology”. My research has involved all the artistic pre-Vesalius human dissectors, Morellian traits of Michelangelo and some fascinating anatomical anomalies shown almost exclusively in known works of Michelangelo as well as on these nude bronzes. The quest has truly been “An Anatomical Whodunnit set in C16th Italy “

Challenges of implementing body donation programs: a multcultural perspective

S065

History of body donation in Berlin

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In Germany, regional law of the 16 federal states ("Länder") regulates funeral practice and postmortem examination, and also anatomical dissection. Berlin therefore has its own "dissection act". This act makes body donation the only legal source of bodies for anatomists. It requires written consent during a donor's lifetime, prohibits financial remuneration, and confines any dissection to anatomy department premises. In Berlin with its history of over 300 years of anatomical dissection, these regulations are a comparably recent development. From the first appointment of a Berlin professor of anatomy in 1713 until after World War I, anatomists occasionally and legally used the bodies of execution victims, but most bodies delivered to the dissecting rooms derived from the Berlin poor, those whose relatives could not afford burial costs. Bodies were mostly delivered by institutions like prisons or hospitals. The times of the "Third Reich" 1933-1945 saw an unprecedented rise in execution numbers, with the bodies legally directed to the anatomy department by an immoral justice system. While we thus know a lot about regulations and body sources until the end of World War II, the history of the post-war introduction of body donation remains to be written. When executions ceased in 1945, a lack of bodies for anatomical purposes ensued during the post-war decades. In West Berlin of the 1960s, donated bodies still only accounted for one third of the bodies available for anatomical dissection. The remainder were unclaimed bodies, a source increasingly opposed by the welfare administration. More successful measures to implement body donation seem to have been introduced in the 1970s, more efficiently in West than in East Berlin. An unequivocal regulation only came in 1996, i.e. after German reunification. More historical research is needed to elucidate how body donation was successfully implemented during this period.

S066

Building up a Body Donation Program – the Portuguese experience

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When developing the first Body Donation Programs, three main challenges presented to the Portuguese anatomical community: religious, legal, and financial.
In Portugal the majority of citizens is Catholic. There is also a substantial difference between the mentality of people living in the metropolitan areas when compared to those living in the province. One of the reasons for this is the very traditional mentality of the people. Changing this mentality is hard. It takes a lot of effort with campaigns, leaflets and most importantly the testimonials of common people that have donated their body. The important thing is that lay people understand of how useful for the society, for future doctors and for science it is to donate their bodies.
For many years, there was no regulatory legal framework for Body Bequests in Portugal. Until 1999, the only reference that could be found in

the law concerning the use of cadavers by medical schools was the Ordinance 40 of 1913. This Ordinance allowed medical schools to obtain the bodies of those dying in hospitals, asylums and public assistance houses provided they had not otherwise been claimed within a 12hr period. Only in 1999 did legislators approve the decree-law of 274/1999 that regulates the use of cadavers in teaching and research. This Decree-Law was based on the 'transplantation law' 12/1993, sharing important resources created by this law, namely the 'RENNDA' ('NON-Donors National Registry'), transposing the 'opt-out regulation' to body donation for teaching and research process.

One other challenge has to deal with the financial burden of a Donation Program. We have solved it with the implementation of a large amount of post-graduation courses and training sessions for surgeons which was the way to convince the Institutional authorities that hosting such a donation program was so important for the Medical School.

S067

The Concept of Establishing A Sustainable Anatomical Donations Program in The Middle East: Assessing the Needs

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The last three decades witnessed a remarkable increase in the number of medical colleges in the Middle East region. There are about 160 medical colleges in the region applying a wide range of medical curricula. There is no sufficient, nor up-to-date information about the use of cadaver dissection in teaching anatomy in those institutions. Nevertheless, a large proportion rely on the availability of human cadavers. Traditionally, unclaimed cadavers made a constant resource. Reliance on unclaimed cadavers is attributed largely to deep cultural considerations and perceptions about death and dissection in general. Unclaimed cadaver supply to medical colleges, especially in the Middle East has always been unsustainable and unpredictable resulting in inadequate availability of specimens for teaching. This fact led anatomy programs in the region to rely on pro-sected specimens and on alternate resources.

The emergence of a new resource in body supply during the past few years helped regional medical colleges to a certain extent in acquiring cadavers when needed. These are donated cadavers supplied from international locations such as Europe, Asia and America. Obviously, the expense for attaining such specimens is usually high. Medical colleges in well-off middle eastern countries could afford these specimens, unfortunately, for the majority, especially the public medical colleges such an option may not exist at all.

The idea of having a body donation program is not new to the region. Such a program, when established and successful, will certainly ensure an adequate supply of appropriate specimens for teaching anatomy. A central advantage of having local donation programs is the positive impact they may have on students' professionalism and the local community.

It is becoming increasingly essential to seriously consider the implementation of valid and sustainable body donation programs to ensure a more effective anatomy education.

S069

Body donation to Departments of Anatomy in Nigeria: Challenges and Prospects

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Cadaver dissection has continued to be a major component of anatomy teaching to medical students in Nigeria. Unclaimed bodies that are released by a designated legal authority are the only source of cadavers. In an effort to assess the level of awareness about body donation, this author administered a questionnaire to willing participants from the university community. None of the participants were medical doctors. All respondents were hearing about body donation for the first time. The idea that a human

being could sign over his body for teaching purposes was unthinkable. In Nigeria, challenges to establishing body donation programs are centred on cultural and religious beliefs and practices. Nigerians value the dead as much as they do the living and a deceased person is believed to be on a journey to a new life where the intact body is needed to function. Donating and mutilating the body through dissection may be interpreted as criminal and a termination of the next level of life for the deceased person. For this reason, the deceased is buried close to his residence or that of his ancestors. This ensures that the memory of that person is kept alive. If a person dies and reference cannot be made to where the body is lying, the relatives have mental and emotional difficulty accepting that the individual is dead resulting in a prolonged period of mourning. A person who donates their own body to teaching and research after death, or that of a relative, may be seen as showing disrespect for family relationships. The prospects for implementing body donation programs for anatomy instruction in Nigeria is bleak and medical teachers think that the current dependence on unclaimed bodies seems to be the only way to go.

S070

Body donation campaigning in conventionally reluctant Asian societies

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In many Asian countries, Confucianism and filial piety discourage body donation. The body is regarded as a gift from the parents that should not be damaged. Moreover, the young are expected to respect the integrity of elder people's bodies after death. Certain groups therefore practice earth burial. The fear of the surviving families that they may have to take the blame for anything ill-fated happening after donation and the difficulties that the survivors are facing on how to get back to normal life also discourage body donation. These social factors are difficult to overcome by reasoning. In addition, the lack of transparency in handling the bodies and the deprivation of surviving families' participation in ceremonies after donation further alienate the public from donating bodies.

In the last two decades, there has been a trend for medical schools in Asia to set up interaction platforms to gain public trust for body donation. Surviving families are arranged to interact with students and jointly participate in ceremonies before and at the end of dissection. These transparency measures turn the conventional one-way pleading for willed bodies to trust-building two-way communication. Participation and interaction encourage students to better appreciate the donation and comfort surviving families. Trust helps the general public to understand the significance of body donation and to better support the surviving families – for whether the survivors agree plays a decisive role in fulfilling the will of the donor in this part of the world.

S071

Challenges that persist in a well-established body donation program

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In the United States, the first law to govern the legal donation of bodies for anatomical use, the Uniform Anatomical Gift Act (UAGA) was enacted in 1968. The University of California operates an Anatomical Donation Program (ADP) that has been accepting donations in support of its education, research and public service mission since the early 1950's, prior to any formal law, when the first location was established at UCLA. Today, the UC ADP has five locations that register and accept donors from the state of California, and from neighboring states in certain circumstances. The program supports the UC system which has 5 academic medical centers and 18 health professions schools including 6 schools of medicine. Other educational institutions and industry companies may also become beneficiaries of anatomical donations to UC when

they have been approved through a standardized review process. Throughout the years, the program has seen fluctuations in registration and donation rates that may correspond to population demographics, to reputational impacts and to outreach efforts or public awareness. Non-academically housed anatomical donation organizations have been established and become more prevalent in recent years and despite several revisions to the UAGA during the past 50 years, anatomical gifts for education and research remains a largely unregulated industry in the United States. There are persistent challenges to addressing the lack of regulation and ongoing efforts to maintaining or increasing registration rates to meet the needs of the university now and in the future. Engaging in public awareness and outreach activities that provide information about anatomical donation as a choice of disposition; that regard donations as honored and respected gifts; and, that focus on the mission of the university, can be effective strategies to address these challenges.

S072

Understanding the Donor Profile: A Fundamental Tool For Body Donor Recruitment in Brazil

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The use of human material in anatomy education is essential and depends on the generosity of altruistic individuals who donate their bodies to medical science. However, little is known regarding the demographics of the donors. In this way, understanding the donor's profile might be used to identify the target audience for campaigns to inform the population about the possibility of donating the body and how to make such a donation. Besides that, to maintain donation programs, it is essential to first understand a sense of public opinion and then adopt strategies to increase donations. Since the beginning of the Body Donation Program for Education and Research in Anatomy (BDP) at the Federal University of Heath Sciences of Porto Alegre, various campaigns have sought to inform the South Brazilian population, about the possibility of voluntary body donation for teaching and research purposes. Donor profile analysis has been used to identify the target audience for campaigns and led to improved results in those campaigns and the structure of the BDP itself. As a result, the number of the registered donors increased, and the program has received enough bodies to meet all of the institution's teaching and research requirements. Therefore, the use of body donor demographics, the motivations of donation, the raise of awareness of the BDP are fundamental data to be considered by universities faced with the problem of acquiring bodies for academic purposes that consider implementing a body donation program.

S073

The need for developing conceptual theoretical frameworks for implementing body donations across the world

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The use of donated cadavers for anatomical research and teaching has in recent years grown rapidly in popularity and has developed a palpable traction over other means of sourcing cadavers, such as the historical use of bodies of condemned prisoners, body snatching and unclaimed bodies. There is a wide variation across history and different world populations on how cadavers are sourced. Unfortunately, most literature describing the motivations and occurrences of body donation programmes across the world has been pitched at practical levels. The aim of the literature review was to reveal the extent of explicit and implicit theoretical work explaining or governing the use of donated cadavers for anatomical research and teaching.
A literature review was conducted in major literature databases discussing donated bodies used for anatomical research and teaching. The literature was combed through to expose explicit

and implicit theoretical work explaining or governing the use of donated cadavers for anatomical pursuits. The literature spectrum covered a temporal period up to 2019 and a worldwide geographic spread.
There was relatively little theoretical work found and was grouped into ethical, psychological, philosophical, geographical, logistical and 'other' categories. The findings of explicit and implicit theories designed for elucidating body donation programmes could help to galvanise debates on body donations by developing common terminology on body donations and raising awareness of key factors on body donations. The theories will be critically analysed to reveal adjustable elements, stages that warrant more research attention and stages that have predictive values. Promising methodologies that may be fruitful in generating new theories will be highlighted. The theoretical work on donated cadavers would encourage the next wave of research on body donation programmes to have a better grasp of conceptual gears and cogs governing the use of donated cadavers. No ethical approval was required.

Forensic clinical anatomy

S074

Forensic Clinical Anatomy. Definition of fields and methodologies. Anatomical variability and medical responsibility.

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Forensic Clinical Anatomy has been defined as 'the practical application of Clinical Anatomy to the ascertainment and evaluation of medico-legal problems'. In this context, the so-called individual anatomy (normal anatomy, anatomical variations, age-, disease- or surgery-related modifications) may acquire specific relevance in the applying of methods of ascertainment and criteria of evaluation in medico-legal analyses (and particularly in cases of supposed Malpractce and Professional Liability).
Anatomical data of forensic interest may arise from the correct application of methods of ascertainment and anatomical methodologies may be required for further comprehensive analysis. The phase of ascertainment is then followed by assessment of a series of evaluation criteria which may be summarized as follows, with particular reference to cases with relevant anatomical aspects: Reconstruction of the Physio-Pathological Pathway; Identification-Evaluation of Errors; Discussion of Causal Value; Damage estimation. The rigorous interpretation of the anatomical data, derived from ascertainment phase and analysed on the basis of pertinent literature, may be pivotal for correct applying of each evaluation step.
Awareness of the relevance of Individual Anatomy should be one of the principles guiding the Clinician to Personalized Medicine; conversely, in Personalized Justice, medico-legal analysis of Medical Responsibility and/or Liability cannot ignore the implications of individual anatomy in terms of ascertainment and evaluation.

S075

Solving clinical problems with anatomical solutions

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Anatomical knowledge, including individual variation, is essential in surgical and other specialities for patient safety and the avoidance of medical malpractice. As anatomists, we have an important role to play, both to assist in the anatomy training of postgraduate medical practitioners, and to provide the cadavers on which they can practise their skills. These skills can be carried out in a safe environment where no harm can come to the 'patient', and where there is no risk of litigation. The introduction of the Thiel soft-fix embalming system, as well as an active body donation programme, has allowed a wide range of surgical courses to be carried out in Dundee. The longevity and properties of the Thiel

cadavers with their flexible, realistic appearance means that several different procedures can be performed on each cadaver, complying with the wishes of the donor to contribute to medical education and research, and providing a high fidelity simulation model for skills training and for the testing of innovative medical devices. Examples of the development of the simulation model will be demonstrated.

S076

Surgical training and development of innovative surgical approaches in the anatomical room. The experience of the Body Donation Program of the University of Padova

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In the last years the cadaverlabs are becoming very popular. Their main purposes are: to improve the anatomical knowledges, to permit the training of complex procedures, to improve the learning curve of new surgical procedures, to teach the ethical approach to dead and cadavers, to evaluate new surgical devices. Indeed many surveys demonstrated that a large proportion of graduating medical students believed that their knowledge of gross anatomy was inadequate for safe medical practice and expressed interest in revisiting the cadaver dissection. Current solutions to limited open operative experience include the use of simulations, but they do not provide sufficient realism and clinical context to substitute for open experience. Indeed the plastic models, computer-generated images and simulators can't replicate exactly the organ fragility and the planes of dissection.
Besides, they reproduce a standard anatomy, and this will compromise the knowledge and understanding of variation required to start practicing medicine safely and competently. At the contrary, students who are able to examine several specimens or are privileged to dissect soon realize that each cadaver is unique. At present, cadavers are the only adequate models for the replication of such procedures. But could exist a medical responsibility for a resident or a surgeon who performed a procedure without an adequate training? Has an hospital to guarantee a sufficient training for its surgeons?
The dissected cadaver remains the most powerful means of presenting and learning anatomy as a dynamic basis for solving problems. The cadaver must not be dismissed as obsolete. Dissection has survived the most rigorous test of pedagogical fitness--the test of time. The student--cadaver--patient encounter is paramount in medical education.

S077

Radiological anatomy and imaging in forensic clinical anatomy

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Computed tomography (CT) and magnetic resonance (MR) have been increasingly used in routine forensic practice and research, and, recently, also in cases of natural deaths. Post mortem CT and MR of single organs is currently applied only for investigation of cardiovascular pathologies. The aim of the present study was to show our experience of radiological analysis of single organs, as an integrative tool for research and forensic applications. The anatomo-radiologic study for forensic purpose was performed on single organs sampled at autopsy and on historical specimens. The specimen underwent CT and MR examinations. Basing on our experience, post-mortem CT and MR on single organ are very useful tool in detection of anatomical variations; diagnosis of cardiovascular pathologies in combination with macroscopic examination and histological evaluation; evaluation of findings shown at post-mortem CT examination of the body and not confirmed by macroscopic examination; analysis of historical anatomical specimens.

S078

The knowledge of limbs anatomical variations to avoid malpractice

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Medical error- the third leading cause of death in the US. But, how many of them could we attribute to a deficit in Anatomical competence? Three have been the causes attributed to Anatomical Incompetence: acknowledge of normal anatomy, unskillfulness and high risk surgery.

The professionals must to know not only the normal anatomy of the different regions of their professional interest, but also their more relevant variations. The ignorance of normal variability may be at the basis of iatrogenic injuries by incompetence and legal responsibility.

Since Vesalius's time the term variability was frequently used and referred to anatomical structures. Several centuries and many dissections were necessary to establish the concept of normality, abnormality and variation of the human body. Now we consider that the terms abnormality, anomaly or malformation are associated with more or less sever functional handicap for the life of the holding person, while variation does not represent a functional handicap for the holding subject.

We review the most more common anatomical variations of bone, ligaments, muscles, vessels and nerves that could be potential factor only for nerve injuries of the limbs: 1) supracondylar process and median nerve; 2) Flexor carpi ulnaris and ulnar nerve; 3) peroneus longus and common fibular nerve and; 4) Plantar fascia and digital nerves; 5) pronator teres and median nerve; 6) Accessory forearm flexor muscles and anterior interosseous nerve; 7) cubital tunnel of the wrist and ulnar nerve; 8) Flexor digitorum longus and tibial nerve; 9) persistent sciatic artery and sciatic nerve; 10) carpal tunnel and median artery; 11) brachioradialis muscle and radial nerve; 12) Piriformis muscle and sciatic nerve.

Conclusions: 1) Medical progress needs a more accurate knowledge of the variability of the human body to improving diagnosis and therapeutic performance. 2) The anatomical variations must be enclosed among the medical curricula. 3) The acknowledge of anatomical variability could be cause of medical responsibility. 4) against incompetence, continuing professional courses, developed by Professional and Scientific Associations, become more necessaries.

S079

My experience as anatomist in medical expertise in orthopaedic and trauma surgery

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Through a personal experience as clinician and anatomist, some points of difficulties in medical expertises are held.

50 recent cases of medical expertise in the field of shoulder and elbow were studied. The type of expertise was assessed, and some examples of limitations of the anatomical knowledge related to the difficulties for concluding the expertise missions were noted, with special overview about the useless investigations in medical imaging and sometimes in therapeutic procedures that could have been performed.

The expertise were simple procedures requested by the medical consultant of insurance companies or contradictory procedures requested by different medical consultants of two insurance companies with no agreement about the causal responsibilities. In 19 cases of severe supraclavicular nerve injuries, the diagnosis had not been evoked, and numerous medical imaging had been performed (MRI, CT Scan), as physiotherapy sessions and some shoulder arthroscopies as well. The concerned nerve was not known. Another recent case concerned the injuries of median, ulnar and radial nerves at the elbow, due to three small fragments of glass (after a car accident), and sustain the difficulty of irritating chronic injury of peripheral nerves with unclear sensory nor motor signs. The anatomical features of the signs had not been depicted, despite it could explain the persistent clinical signs 4 years after the accident. A case of ulnar

nerve entrapment due to a variant anconeus epitrochlearis muscle was also recorded, with no diagnosis made by the radiologist on MRI and wrong conclusion of the medical expertise.
Through different examples of rare pathologies but undiagnosed because of absence of knowledge of anatomy of the concerned region nor anatomical variation, the question is stated about which limitations should we consider in the anatomical skills for a reliable clinical expertise.

S080

Supporting structures in the lateral side of the knee

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The morphology of anterolateral ligament (ALL) has been reported by many researchers. However, whether ALL is an extra-capsular structure or just a capsular thickening has been controversial. Generally, a ligament is defined as a structure connecting two points. Based on this definition, we hypothesized that ALL could be an extension of fibrous tissue such as the joint capsule rather than a specific ligament. We would like to discuss the supporting structures in the lateral side of the knee from the perspective of the joint capsule.
A total of 27 knees from 19 cadavers were used in the current study. This study complied with the Japanese Act on Body Donation for Medical and Dental Education. The knee joint capsule was peeled away, and the width of the capsular attachment to the tibia was measured. The capsular attachment was histologically analyzed, and the serial sections were used to analyze the layer composition of the joint capsule.
At the posterior border of Gerdy's tubercle, which is the insertion of the iliotibial band, the capsular attachment was wide. It gradually tapered toward the posterolateral aspect. Finally, it became linear at the apex of the head of the fibula. Histological analysis at the posterior border of Gerdy's tubercle revealed developed uncalcified fibrocartilage on the capsular attachment. Connective tissues which were attached to the posterior border of the Gerdy's tubercle were continuous to the fascia lata and the fabellofibular ligament.
The attachment width of the knee joint capsule in the lateral side varied according to location. We considered that this finding on the joint capsule will facilitate an understanding of the pathology of diseases on the lateral side of the knee. Additionally, better understanding of the continuous relationship between adjacent structures could be important to improve rotatory function of the tibia.

S081

Forensic Implications of Anatomical Variability of the Vascularization of the Brain

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The blood supply to the brain has been well studied. Variations are relatively common but such morphological findings have not been, to our knowledge, examined from a forensic clinical anatomy perspective. The speaker will describe common and rare anatomical variations of the blood supply of the brain including its venous drainage and discuss their applications to the new field of forensic clinical anatomy and its potential contributions to medicolegal issues.

S082

Applied, Clinical Anatomy in Endocrine Surgery: Modern Requirements for Thyroid and Parathyroid Interventions

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Modern translational anatomic research of endocrine surgery concerns the field of the Intraoperative Neuromonitoring (IONM) and ultrasonography (US). IONM and US are both well-established methods to prevent nerve palsy during operations and to elucidate pathomechanisms in disease.
Anatomic dissections of 204 hemilarynges were performed to study the topography of the inferior laryngeal nerve (ILN). Measurements were taken from the lower rim of the cricoid and from the Zuckerkandl tubercle to the beginning of the furcation of the ILN. Anatomic variations such as a non-recurrent inferior laryngeal nerve (nrILN), produced possible explanations for different IONM-signals which would correlate with differences in the anatomic course of the inferior laryngeal nerve. Preoperative US was performed to evaluate the presence of a brachiocephalic trunk and the recurrent laryngeal nerve for exclusion or identification of a nrILN.
For identification of the ILN the cricoid offers a suitable intraoperative landmark. A single branch existed in 5% of specimens on the left and in 3% on the right side. Bifurcation was present in 72.5% and 62% and trifurcation in 18% and 29% of cases, respectively. IONM-signals during thyroid surgery, derived from the vagus nerve were positive if derived proximal to and negative if derived distal to the branching off a nrILN. By ultrasonographic identification of a normal brachiocephalic trunk, a nrILN could be excluded.
IONM and preoperative US can be reliable tests in recognizing peripheral nerves and their variants. Translational anatomic research and its application on peripheral nerves improve surgical outcomes and individual patient quality of life - from “bench-to-bedside”. This is achieved by increasing individualizing, enlightening under-investigated anatomic details and optimizing surgical procedures.

S083

Embryological bases, surgical implications and medical liability of abdominal surgery.

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The embryological development of the gastrointestinal tract and its associated mesentery is complex. Despite the low prevalence of congenital gastrointestinal there is a wide variety of veils, folds, and membranes, collectively termed peritoneal bands, that may still cause clinical symptoms. Anatomically, these structures are unabsorbed portions of the omentum and mesentery and are most commonly located in the duodenum, duodenojejunal flexure, ileocecal junction, and ascending colon. As a consequence of their variable location these structures manifest a highly variable range of symptoms mimicking acute intestinal necrosis, vague abdominal pain, acute abdomen and many others. Considering their benign nature these structures are often implicated in medicolegal cases of abdominal surgery.
This presentation will highlight the importance and distribution of the various abnormal
peritoneal folds, bands, and ligaments, the appropriate diagnostic studies and
treatment interventions required for these variant structures and their implication in medicolegal cases.

S084

Forensic Clinical Anatomy of Child Abuse

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Child abuse may be considered one of the main fields of investigation of Forensic Clinical Anatomy. Individual anatomy (which acquire a particular importance in Forensic Clinical Anatomy) may be defined as the anatomy of that

specific person considered in the particular moment of clinical and/or forensic relevance. In this sense, the anatomy of the child is particularly 'individual' as strictly related not only to possible anatomical variations but al-so to development and maturation.
In Child Abuse (in all its forms), problems of differential diagnosis between anatomical structures (normal or variant) and pathological findings frequently arise. For instance, Mongolian spot may be included in the anatomical variability of the skin in a developmental context but this condition may be difficult to be differentiated from ecchymoses, both in clinical and necroscopic contexts. Additional variant skull sutures may also be in differential diagnosis with abuse-related skull fractures.
Forensic Clinical Anatomy of Child Abuse includes studies of Functional and/or Biomechanical Anatomy which are performed on cadavers to verify compatibility of lesions with accidental dynamics. For instance, studies involving pediatric cadaver drop tests are present in literature, for better evaluation of the forces needed to produce skull fractures.
Some kinds of damages following Child Abuse are also strictly anatomical in nature and require morphological/morphometric methods of investigation for adequate assessment. For instance, structural gray and white matter changes have been reported through imaging techniques in subjects who experienced childhood trauma, with and without post-traumatic stress disorders, as result of plasticity response of the central nervous system.

The mesentery – new insights into its anatomy, development and role in disease

S085

The Anatomy of the mesentery

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There has been a recent appraisal of mesenteric anatomy that has departed from the conventional model which describes multiple, separate "mesenteries".
This concept of a continuous mesentery is not new. This design was depicted by Renaissance anatomists. The replacement of a continuous with a fragmented model span several centuries.
The scientific and clinical community seems to have returned to Renaissance model.
This presentation will present evidence in support of the helical model and describe our current understanding of mesenteric anatomy.

S087

Clinical Imaging of the Mesentery

Manish Chand[1]
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The mesentery plays an important role in surgical disease. However more recently the traditional anatomical basis of the mesentery being made up of several distinctive units corresponding to different segments of the gastrointestinal tract (GI tract) has been challenged. The novel model describes a continuous and contiguous independent organ which fans out from the posterior abdominal wall in a spiral configuration.
A new understanding of the mesentery and its anatomy has profound implications on treatment planning and surgery for various diseases of the GI tract. Clinical imaging has revolutionised the way surgeons treat disease but is reliant on a strong understanding of human topography. Whilst CT and MRI remain the mainstay imaging modalities of the GI tract, radiologists require experience to interpret the parallel and cross sectional images of the 3D body. The radiologist needs to have an appreciation of the anatomical structures as they construct a 3D assessment of the anatomy. The mesentery is well seen throughout the abdominopelvic cavity although there are certain areas which are more pronounced. Understanding how the mesentery evolves and then positions itself as a continuous spiral structure is essential to offering accurate staging of disease.
An accurate anatomical and radiological understanding is the basis for pre-operative planning of surgical disease. The importance of

specific areas of the mesentery such as the mesorectum in rectal cancer have been known for some time. Correctly assessing the extent of mesenteric involvement in both benign (eg Crohn's Disease) and malignant (colorectal cancer) disease is vital to offering patients optimal treatment and reducing the risk of recurrence.

S088

Mesenteric organogenesis

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Recent advances in mesenteric anatomy show that the mesentery is a continuous and substantive organ, spanning oesophagogastric junction to mesorectum. These advances represent a change in the anatomical endpoint of mesenteric development. To date, no studies have characterised the development of the mesentery since its reappraisal as a continuous organ.

Using histological sections and advanced image analysis, we have performed reconstructions and simulations of mesenteric development. Four-dimensional visualisation of the mesentery enabled characterisation of mesenteric morphogenesis. We characterised the development of associated digestive organs.

Direct visualisation of mesenteric morphogenesis facilitated novel insights into mesenteric development. Throughout development, the mesentery is continuous from oesophagogastric junction to mesorectum. In contrast with classic teaching, rotation around the root of the superior mesenteric artery does not occur. Abdominal digestive organs develop within the mesentery, indicating that the mesentery may act as an incubator for abdominal digestive organs. These findings correlated with cadaveric and scanning electron microscopic studies of the mesentery.

These findings allow a clarification of the definition of the mesentery. The mesentery is the organ that, in the embryo, supports the development of abdominal digestive organs, and following birth, maintains abdominal digestive organs in position and continuity with other systems. Further studies are required to translate these findings to surgical practice.

S089

The Mesenteric Microbiome

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Mesenteric lymph nodes are sites in which translocated bacteria incite and progress immunological responses. For this reason, understanding the microbiome of mesenteric lymph nodes (MLNs) in inflammatory bowel disease is important.

To date, there has been limited focus on elucidating the bacterial profile of Crohn's disease MLNs using culture-independent methods. Our work is unique in molecular investigation and comparison of the MLN microbiota from both Crohn's disease and ulcerative colitis patients.

Our findings identified microbial diversity that distinguishes Crohn's disease and ulcerative colitis. Furthermore, our most recent results expand this proposition to suggest a novel non-invasive diagnostic test, based on bifurcated immune responses, capable of differentiating Crohn's disease colitis from ulcerative colitis. This has particular clinical relevance to indeterminate colitis.

S090

A general model for abdominal anatomy across mammalian species and based on mesenteric anatomy

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Recent clarification of mesenteric anatomy below the level of the duodenum has led to a clarification of abdominal digestive system anatomy distal to this level. As a result it was postulated that investigation of mesenteric form proximal to the duodenum could yield a similar clarification. Moreover, collation of anatomical

findings related to the mesentery above and below the duodenum could provide an anatomical model that was applicable at all levels in the abdomen. In keeping with this possibility we investigated the shape of the mesentery proximal to the duodenum and collated findings with those below the duodenum. We found that all abdominal digestive organs are directly connected to a single and continuous mesenteric frame, rather than to the posterior abdominal wall. This and other findings allow us generate a new model of abdominal compartmentalisation. Accordingly, the abdomen and its contents are organised into mesenteric and non-mesenteric domains. The lecture will explain the new general model of abdominal anatomy. It will describe how this model is mesenteric-based, and that it explains the spatial organisation of all abdominal digestive organs, embryological development of these, and the peritoneal landscape in general. The mesenteric-based model of abdominal compartmentalisation is the first to reconcile embryological, anatomical, surgical and radiological approaches to the abdomen and contents.

Recent developments in neuroanatomical terminology

S091

Recent developments in neuroanatomical terminology, an introduction to the TNA and beyond

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A recent revision of the terminology of the central and peripheral parts of the nervous system as well as of the sensory organs from the Terminologia Anatomica (1998) and the Terminologia Histologica (TH 2008) has been posted to the open part of the Federative International Programme for Anatomical Terminology (FIPAT) website (http://FIPAT.library.dal.ca) as the official FIPAT terminology for the nervous system and the sensory organs, the Terminologia Neuroanatomica (TNA). In general, the TNA uses a more natural hierarchical and embryologically-based classification of brain structures for the prosencephalon (forebrain), following the influential prosomeric model for the brain. Neuron types are implemented in all of the sections. Given these novelties, involving a framework change in the prevalent neuromorphological descriptive paradigm (that is the current prosomeric model versus Herrick's columnar model), and their potential impact on the future communication of neuroanatomical research data, the scientific community might profit from a wider discussion of the FIPAT's decisions. This symposium includes an overview of the TNA, a contribution on the prosomeric model and its implications for neuroanatomical terminology, a contribution on the "pons" problem and the increasing importance given to the isthmus today, a contribution on DTI versus postmortem dissection of long association tracts of the cerebral cortex, a contribution on a common terminology for the thalamic nuclei and one on the terminology for the pain circuitry from the spinal cord until the insula. In this overview, some examples of the CNS Chapter of the TNA will be presented, focussing on the cerebral cortex, and on the next step in the TNA, its data base implementation, the classification of fibre tracts in particular. Future developments will include a merging of the TNA data with the embryological terminology from the second edition of the Terminologia Embryologica.

S092

Terminological and conceptual problems arisen in forebrain neuroanatomy due to implementation of the prosomeric model.

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The traditional columnar model of the forebrain has proven unable to account for many novel

data produced thanks to the modern application of molecular gene mapping to developmental and adult neuroanatomy (genoarchitecture). The emergent new morphologic paradigm (Bauplan) that seems consistent with the new scenario is offered by the prosomeric model. This basically redefines the length axis according to W. His 1893 (relative to the notochord), and postulates global dorsoventral and anteroposterior patterning and regionalization mechanisms which create respectively longitudinal zones and transverse neuromeres (brain segments). The orthogonal intersection of these structural elements creates fundamental floor, basal, alar and roof regions of each neuromere (neuromeres are metameric in their display of a shared organization plan). These primary regions can still be subdivided by the effects of secondary organizers into definitive progenitor domains (e.g., isthmic and mid-diencephalic organizers, or continued patterning effects caused by the floor and roof domains of the brain). Progenitor domains represent neuroepithelial areas uniquely specified in their molecular profile. The latter, a code of some 100 genes, subsequently guides differential proliferation, neurogenesis, glial structure, cell migration and stratification, adhesivity properties, axonal navigation and synaptogenesis, that is, histogenetic development of characteristic brain structure at specific parts of the brain wall. In the forebrain the neuromeres are termed 'prosomeres', and that is the origin of the 'prosomeric model', though this has come to encompass the whole brain. Implementation of this new brain structural model, clearly more powerful for causal explanation and functional analysis than the obsolete columnar model, has confirmed some old neuroanatomic conceptual tenets, but has also raised a number of discrepancies about anatomic boundaries and the ascription of brain entities to given territories. Importantly, the return to His' length axis, which accepts the reality of the cephalic flexure, has implied alternative meanings of the traditional anatomic descriptor terms.

S093

An urgent need to update brain stem nomenclature, based on the evidence from developmental gene patterns

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The traditional subdivision of the brain stem into midbrain, pons, and medulla oblongata is based purely on the external appearance of the human brain stem and cannot be sensibly applied to most other mammals. There is an urgent need to update the names of brain stem structures to be consistent with the discovery of neuromeric segmentation based on gene expression. Almost all current neuroanatomy text books have failed to recognise the implications of modern studies on brain stem development. The most important mistakes are the belief that the pons occupies the upper half of the hindbrain, the failure to recognize the isthmus as the first segment of the hindbrain, the belief that the substantia nigra belongs only to the midbrain, and the mistaken inclusion of diencephalic structures in the midbrain. We recommend the adoption of a new brain stem nomenclature based on developmental gene expression, progeny analysis, and fate mapping. In this system the midbrain is divided into two mesomeres (m1 and m2), and the hindbrain is divided into four regions, prepontine (isthmus and rhombomere 1), pontine (rhombomeres 2-4), postpontine (rhombomeres 5 and 6), and medullary (rhombomeres 7-11). The cerebellum arises from the prepontine region. Our new proposed nomenclature will apply to all mammals and is consistent with the organisation of the brain stem in non-mammalian vertebrates.

S094

Towards a new anatomy of association fibre tracts of the cerebral cortex

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Mapping white matter connections of the human brain is a thriving field. In the last 20 years, the development of diffusion tractography methods has revealed characteristics of large white matter association tracts that are essential to our understanding of human cognitive functions and behaviour. However, about half of the human brain connections remain unknown and many novel tracts that have been recently described with tractography still await validation.
In this presentation we focus on the results of a new comprehensive atlas of the association tracts of the human brain based on advanced tractography and complementary histological approaches. Principles of white matter organization and classification revealed by the new maps will be discussed. Examples of individual tracts, their interindividual variability among the general population, and possible functional correlates will be presented. A particular feature of the atlas is the visualization of the unique pattern of distribution of short U-shaped fibres. Preliminary comparison across species and clinical-anatomical correlation studies indicate unique features and functions of some of the new association tracts in the human brain.
We believe that the atlas may provide a valid framework for neurosurgical mapping and ongoing revisions of the international neuroanatomical nomenclature.

S095

Toward a Common Terminology for the Thalamus

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Inconsistencies in terminology become obvious when the correspondence between discriminated areas of the human thalamus in different atlases is queried. Differing parcellations with limited cross-correspondence between atlases of the human thalamus and differing terms for equivalent regions raises problems as the utility of neuroanatomical methods for modern computer analysis of the brain is increasingly appreciated. However, a harmonized or even unequivocal nomenclature is imperative to understand the organization of the thalamus. This situation cannot be improved by renewed discussion, but by implementation of neuroinformatics tools.
We have chosen a new volumetric approach to characterize the significant subdivisions, and determined the relationships between the parcellation schemes of nine of the most influential atlases of the human thalamus. The volumes of each atlas were 3d-reconstructed and spatially registered to the standard MNI/ICBM2009b reference volume of the Human Brain Atlas in the MNI (Montreal Neurological Institute) space (Mai and Majtanik, 2017). This normalization of the individual thalamus shapes made it possible to compare the nuclear regions delineated by the various authors. Quantitative cross-comparisons showed the extent of territorial boundaries predictability for eleven cluster areas.
In discordant parcellations we re-analyzed the underlying histological features and the original descriptions. The final scheme of the spatial organization provided the framework for the selected terms for the subdivisions of the human thalamus using on the (modified) terminology of the Federative International Programme for Anatomical Terminology (FIPAT). The abandonment of a precise individual definition of regional boundaries in favor of statistical representation within the open MNI platform provides the common and objective (standardized) basis for matching results from different sources (microscopy, imaging etc.).

S096

A review of the terminology for the pain circuitry from spinal cord to the insula

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Recent decades have witnessed important developments in our understanding of how pain and other interoceptive modalities such as temperature and itch sensations are propagated through the central nervous system to the cerebral cortex in primates including man. The peripheral endings of nociceptive-specific primary afferent Aδ and C-fibers detect painful stimuli and transfer the signals through peripheral nerves and the dorsal roots to the spinal cord, where these fibers preferentially terminate in laminae I-II of the superficial dorsal horn. The signals are transmitted either directly or indirectly through networks of local circuit neurons in laminae I-II to modality-specific projection neurons in lamina I. The latter neurons emit axons that cross the spinal midline and ascend in the lateral funiculus to terminate in a number of brainstem sites and in the thalamus. In the thalamus two main termination sites of axons from lamina I neurons have been detected, the ventrocaudal part of the medial dorsal nucleus (MDvc) and the posterior part of the ventral medial nucleus (VMpo). Neurons in MDvc project to the anterior cingulate gyrus, often referred to as the limbic motor cortex. The VMpo has an anteroposterior somatotopic organization and its main projection target is located in the granular cortex of the dorsal posterior insula, in the fundus of the superior limiting sulcus, where antero-posterior somatotopic maps of the interoceptive modalities are also evident. This cortical region, together with the adjoining anterior area receiving visceral inputs through the solitary tract nucleus and the basal ventral medial nucleus, is referred to as the interoceptive cortex and serves as the primary cortical representation of the interoceptive modalities. Further cortical processing of interoceptive inputs including pain takes place in the mid-insula and then in the anterior insula, the latter referred to as the limbic sensory cortex.

Local circuits related to function and disease in the central nervous system

S097

Oligodendrocyte myelination: an essential factor for neural circuitry establishment and a new therapeutic target for neonatal white matter damage

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Oligodendrocytes (OLs) wrap axons and form myelin sheaths, which guarantee efficient transmission of nerve impulses. CNS myelination occurs in a specific region in a time window which is overlap with synaptogenesis. But it remains unclear how myelination impacts the development of neuronal circuitries. Here we seek to understand potential impact of myelination in synaptogenesis by manipulating myelination in the M1R (a negative regulator) or Olig2 (a positive regulator) conditional knockout mice. We demonstrated that hypomyelination disrupts synaptogenesis and synaptic transmission and impairs Neuronal function. In addition, we demonstrated that enhancing myelination rescues synaptic deficits and drug-based myelination therapies also resulted in accelerated differentiation and myelination with functional recovery after chronic hypoxia. Together, our data indicate that myelination enhancing strategies in preterm infants may represent a promising therapeutic approach for white matter injury (WMI) or other myelination disorders.

S098

Transcriptional expression inhibition of SV2C selectively localizing in basal ganglia by mutant huntingtin and the implication for the brain region-

selective pathology of Huntington's disease

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Huntington's disease (HD) is a neurodegenerative disease characterized by a general shrinkage of the brain and degeneration of the striatum (caudate nucleus and putamen), with specific loss of efferent medium spiny neurons (MSNs). Although the striatum appears to be the most affected region of the brain, a regionally specific thinning of the cerebral cortex was found in patients with HD. HD is due to the expansion of the CAG repeats in the exon 1 of IT15 gene encoding huntingtin (Htt), which are translated into an abnormally long polyglutamine tract in Htt. Mutant Htt causes synaptic transmission dysfunctions by interfering in the expression of synaptic proteins, leading to early HD symptoms. Synaptic vesicle proteins 2 (SV2s), a family of synaptic vesicle proteins including 3 members, SV2A, SV2B, and SV2C, plays important roles in synaptic physiology. Here, we report that the protein levels of SV2A and SV2B are not significantly changed in the brains of HD transgenic (TG) mice expressing mutant Htt; however, the protein level of SV2C, which has a restricted distribution pattern in regions particularly vulnerable in HD, is dramatically decreased in the TG mouse brain. RT-PCR analysis demonstrated that the mRNA level of SV2C progressively declined in the TG mouse brain without detectable changes in the mRNA levels of SV2A and SV2B, indicating that mutant Htt selectively inhibits the transcriptional expression of SV2C. Furthermore, we found that only SV2C expression was progressively inhibited in N2a cells expressing a mutant Htt containing 120 glutamine repeats. These findings suggest that the synaptic dysfunction in HD results from the mutant Htt-mediated inhibition of SV2C transcriptional expression. These data also imply that the restricted distribution and decreased expression of SV2C contribute to the brain region-selective pathology of HD.

S099

Local GABAergic Transmission on Pyramidal Neurons in Prefrontal Cortex: A Potential Therapeutic Target for Adolescent Substance Users

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Substance use during adolescent period has been thought to increase the risk of psychiatric disorders in later life, but the underlying molecular mechanism remains unclear. Adolescent brain is still under quick development, and is much more sensitive to drugs toxicity than that of adult.

Pyramidal cells are the main projection neurons in prefrontal cortex (PFC), and their transmitting roles are controlled by the balance of excitatory and inhibitory (E-I) inputs. Impairment of E-I balance on the cortical pyramidal cells has been thought to involve in the pathology of psychiatric disorders such as schizophrenia, autism, intellectual disabilities and addiction. In PFC, the main elements of the microcircuits are inhibitory GABAergic interneurons and excitatory glutamatergic pyramidal cells.

In this study, we hypothesize that adolescent cocaine exposure results in long-term deficits in local GABAergic transmission on the pyramidal neurons in PFC, which contributes to the high risk of psychiatric disorders in adulthood. Animals were administrated with cocaine from postnatal day 28 (P28) to P42, a period that represents adolescent time in rodents. Indeed, animals with a history of cocaine exposure during adolescent period exhibit an enhanced anxiety-like and depression-like behaviors in their adulthood. In parallel, an increased GABAergic transmission to pyramidal neurons in adult PFC was found in cocaine-experienced mice, as indicated by morphological, electrophysiological, fMRI and biological evidences. Paravalbumin-expressing

(PV+) interneurons give rise to oscillatory activity in the gamma-frequency ranges, and belong to fast-spiking GABAergic interneurons. In the future study, we will use PV-Cre animal models and optogenetic methods to investigate if suppressing the activities of microcircuits between local GABAergic interneuron and pyramidal cells in PFC could ameliorate adolescent substance use-caused psychiatric disorders.

S102

Facilitation sensory excitatory transmission through direct descending projection from the anterior cingulate cortex to the spinal dorsal horn in the rat

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Spinal dorsal horn is a critical modulatory region for the chronic pain. Sensory information transmission within the spinal dorsal horn is usually biphasically modulated by descending projections, in which the descending facilitation is believed to contribute to chronic pain. Descending modulation from the brainstem rostral ventromedial medulla (RVM) has been studied extensively, whereas little is known about direct corticospinal modulation. In order to provide evidence for this issue, the descending modulation effects of the direct corticospinal projection on the sensory information transmission in the spinal dorsal of the rat were investigated by using neurobiological methods. All procedures were approved by the Ethics Committee of Animal Use for Research of all 3 universities in China, Canada, and Japan. The best attempts were made to minimize the number of animals used as well as the suffering of the animals. A model of neuropathic pain in rats was induced by the ligation of the tibial nerve and common peroneal nerve. In the neuropathic pain rats, it was found that stimulation in the anterior cingulate cortex (ACC) potentiated spinal excitatory synaptic transmission and this modulation is independent of the RVM. Peripheral nerve injury induced by the ligation of the nerves enhanced the spinal synaptic transmission and occluded the ACC-spinal cord facilitation. Inhibition of ACC reduced the enhanced spinal synaptic transmission caused by nerve injury. Finally, the results of optogenetic approach showed that selective activation of ACC-spinal cord projecting neurons caused behavioral pain sensitization, while inhibiting the projection induced analgesic effects. The present results provide evidence for that ACC stimulation facilitates spinal sensory excitatory transmission by a RVM-independent manner. The significance of these findings is that such top-down facilitation exerts from the direct descending projection from the ACC to the spinal dorsal horn might contribute to the process of chronic neuropathic pain.

Digital technology and teaching methods in anatomical education

S103

Knowing Where to Look May be Half the Battle: Eye-tracking and Cerebral Blood Flow in High and Low Spatial Ability Students

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Spatial ability is a cognitive asset to learners in STEM (science, technology, engineering, and math) disciplines. It is thought that anatomy comprehension requires the learner to create malleable mental models that may be manipulated to ascertain location, context, and to recognize variability or pathology. It is understood that as knowledge of specific regional

anatomy grows, the dependence on innate spatial ability declines. This presents a challenge to educators, our low spatially able (LSA) novice learners. High spatial ability (HSA) is thought to provide academic advantage as the learner orientates, finds meaning, and learns more per unit time of instruction and does so with hypothesized lower cognitive load. This presentation will give an overview of cognitive load and make the association with spatial ability in the learner through two lines of ethically sanctioned research. Comparing HSA to LSA student groups using Transcranial Doppler (TCD) ultrasound, cerebral blood flow in HSA learners was greater than LSA counterparts during identical tasks. Students with LSA received lower test scores in both static and dynamic tests of anatomy yet in qualitative questionnaires they indicated the questions were not challenging. Does this suggest a perceptual mismatch? We approached the question using eye tracking. Persons of LSA visually attend to different regions of images within mental rotations tests suggesting they cannot find salient features as quickly or as accurately to derive meaning as their HSA counterparts. Not all is lost, through visual cueing, LSA individuals scored significantly better on similar future tests despite not receiving feedback. The positive effects on spatial ability test scores continue well after visual coaching suggesting the change in visual search strategy is enduring. Together, this research informs pedagogic practice suggesting spatial ability mediation reduces cognitive load and increases learning in lower spatial ability individuals.

S104

Visualization: Building and Utilizing Stereoscopic Virtual Models for Anatomy Education and Clinical Training

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Stereoscopic three-dimensional (3D) technology has undergone increasing advances and has been used more frequently in anatomical education in recent years. Due to reduced lecture hours and lab hours, many health related universities look for more efficient teaching techniques such as 3D technology to implement in their anatomy curriculum. However, whether 3D technology will be beneficial to student learning of anatomy, and how to effectively develop 3D stereoscopic models are still debatable. We used various data (CT, MRI, CTA, and MRA) and methods of surface rendering, volume rendering, and semi-auto combined rendering to develop stereoscopic anatomical models for anatomical education and surgical training purposes. We implemented stereoscopic models in student learning of anatomy. In this presentation, several scales of stereoscopic techniques and visualization will be addressed. Various approaches to generate stereoscopic models using different data, their advantages, and their disadvantages will be discussed. Finally, we will review current evidence of evaluating stereoscopic 3D learning, by comparing flat screen images, monoscopic 3D models, and stereoscopic 3D models in medical student learning of anatomy.

S105

Stereoscopic Learning and Health Sciences Students' Retention of Anatomy: Does the "Popping Out" Effect Make a Difference?

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With today's ever-evolving technology, digital tools are becoming more proliferative in anatomy education. Many studies have explored the instructional efficacy of virtual anatomical models in various virtual three-dimensional (3D) display formats for various cohorts of learners. However, these studies collectively have produced mixed

results. Many of these studies lack reporting on the validation process for the models used in educational research, and many more do not explore their impact on learners' long-term retention. The purpose of this symposium presentation is to discuss relevant educational studies from our lab exploring the impact of monoscopic and stereoscopic virtual 3D anatomical models on various learners' performance outcomes and long-term retention. These studies were approved by the IRB at the University of Mississippi Medical Center. These studies examined the relationships between first-year medical and dental students' exposure to different learning modalities and their short- and long-term learning outcomes. Our studies compared the impact of traditional learning and virtual stereoscopic learning using pelvis and middle and inner ear models and compared monoscopic and stereoscopic learning using pelvis and middle and inner ear models. Results from repeated measures ANOVAs have shown significantly higher short-term post-3D test scores compared to pre-3D test scores, but they did not show significantly higher long-term post-3D test scores. There was no significant difference ($p=0.502$) between traditional and virtual stereoscopic learning with pelvic anatomy and no significant difference ($p=0.069$) between monoscopic and stereoscopic virtual middle and inner ear models, even when students' spatial abilities were considered. These results suggest that monoscopic and stereoscopic virtual 3D models can perhaps improve students' short-term retention after their learning experience, but not necessarily their long-term retention. Monoscopic and stereoscopic virtual models may be beneficial supplements to traditional anatomy instruction, but neither may be more superior to the other.

S106

The role of mental processes in conceiving, developing and validating 3D human anatomy learning tools for undergraduate allied health sciences students

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Understanding human anatomy requires several mental processes: i) mental imagery: the ability to mentally represent a physical object, a concept or a situation; ii) mental rotation: the ability to mentally turn the image of an object in the three space planes; iii) motor imagery: the ability to imagine a human movement without any real movement execution. These mental processes have been used in Lyon 1 university to conceive and develop hundreds of 3D animations that are used to teach anatomy for undergraduate allied health sciences students, especially kinesiology students. All our animations are available in our YouTube Chanel "Anatomie 3D Lyon". Our approach is experimentally validated through several paradigms. For instance, we found a significant correlation between anatomy examination results and visuo-spatial ability tests (Guillot et al., 2007). We also showed that mental rotation training enhanced the acquisition of anatomical information requiring visuo-spatial ability (Hoyek et al., 2009). Our 3D animations, when used in real learning condition, enhance the acquisition of anatomy knowledge requiring spatial ability as compared to 2D images (Hoyek et al., 2014). We further showed the efficiency of 3D animations compared to static 3D images in the mental representation and description of the scapula (Berney et al. 2015). In sum, 3D animations are efficient in teaching and learning anatomy, however their passive visualization lacks interaction, which is essential for anatomy learning. In our actual funded projects (Antepulsio and An@tomy 2020) we are developing new interactive tools that allow both personal body experience and good spatial representation of anatomical structures. Our new prototypes as well as our related preliminary results will be presented during the conference.

All our experiments were approved by our local ethic board. They were conducted on our kinesiology students with their understanding and consent.

S107

Is teaching Histology in 3D useful?

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Histology education uses sections where students are challenged to translate 2D observations into a 3D understanding of structural-functional relationships at the microscopic level. While in gross anatomy, virtual 3D models help to interpret cross sectional images, it is not known whether similar tools are effective in histology education. To overcome this cognitive hurdle, we generated a virtual 3D model of a serially sectioned and digitally segmented renal corpuscle and developed an interactive virtual learning tool (VLT). The VLT enables users to explore the renal corpuscle by superimposing the sections over the 3D model in 3 orthogonal planes. To learn how best to implement the VLT in a histology curriculum we performed two separate educational studies comparing learning with the VLT in a guided and unguided format to traditional exploration of 2D sections. We considered students' prior histology knowledge, spatial ability, and learning styles. Before learning with one of the 3 modalities, participant completed a pre-knowledge test, and either a spatial ability test, or the VARK learning style survey. A post-test compared learning outcomes. When participants were ranked into tertiles according to pre-test scores, those with the lowest pre-knowledge, that learned with the VLT in a guided format, had a significantly higher change in test scores compared to all other learning modalities. Furthermore, a significant correlation between spatial ability and change in test scores was found only for those that learned with 2D sections. In comparison to multimodal leaners, unimodal learners were disadvantaged when studying with 2D sections. A qualitative questionnaire revealed a high positive attitude towards the VLT. When introducing virtual 3D tools into Histology curricula, the mode of instruction, and the level of student knowledge should be taken into consideration in order to achieve best possible outcomes. This study was approved by the Research Ethics Board of Western University.

S108

Utilising Tablet PC and Mobile Platform for Task Based Learning and Peer Assessment in Histology and Gross Anatomy Dissection Labs

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The School of Biomedical Sciences currently offers classes in anatomy and histology to students from a variety of undergraduate healthcare professional programmes. Over the years, based on teaching experience, feedbacks from students and teachers, and comments from external examiners, we have identified disadvantages of our traditional anatomy and histology pedagogies. In a traditional anatomy practical class, each teacher is required to oversee several stations/cadavers and supervise many students constantly throughout the whole duration of the class, their workload is extremely high. It is also difficult for the teachers to provide comprehensive guidance for every student. The disadvantages of traditional microscope-based histology teaching include focusing on memorization rather than application of the knowledge, and lacking interaction with the students.

With the aim of converting instructional anatomy and histology classes into indispensable active-learning experience, we are developing E-resources and active-learning pedagogies to

complement the current curriculum reform. We are creating interactive histology E-platform with digital atlas, discussion forum, and demonstration videos, and introducing technology-supported task oriented practical (TOP) to transform the anatomy and histology practical sessions. With the support of demonstration videos, interactive E-resources and tasks delivered by tablet computers, digital smart board and VR/AR facilities, students are able to utilise their basic and clinical knowledge to complete tasks assigned for each learning stations. We are also introducing the dissection peer-support system (DPSS) utilising mobile learning platform iClass. Through DPSS, students learn key points and dissection techniques from the videos created by peer groups; they are also provided with the rare opportunity to compare the anatomical variations and pathological features of all cadavers provided for the class.

These innovative pedagogies enable students to participate actively in learning and applying knowledge, stimulate the students' interests, provide enhanced learning experience, and help the students to achieve deep learning.

HKU/HA HKW IRB, Ref: UW 19-277.

Fascial Net Plastination Project (FNPP)

S109

Can Medical Education be Enhanced by the World's First 3d Printed Fascia Model and Plastinated Specimens of Fascia Superficialis and Profundus?

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Since the 1st International Fascia Research Congress (IFRC) in 2007 subsequent increases in fascia related research articles published by several journals, most notably the Journal of Bodywork and Movement Therapies (JBMT), has seen fascia established as an important topic in medical science generally and anatomy specifically.

Due to the nature of fascia, its architecture and ubiquitous characteristics, it is difficult to visualize an image of fascia that would do justice to this omnipresent three-dimensional connective tissue (for educational purposes) without the aid of anatomical specimens and models. Fascia can be seen as the dark matter of our inner universe weaving a supportive fabric that without which we would have no body. Accurate anatomical specimens of the superficial and deep fascia would be welcome visual and tactile educational aids in medical teaching facilities and departments of anatomy worldwide. In 2017 Dr. Robert Schleip, head researcher at Ulm University in Germany approached the world-renowned von Hagen's Plastinarium in Guben on behalf of the Fascia Research Society. Dr. Schleip sought to investigate possible interest in supporting a proposed research initiative entitled "Fascia Net Plastination Project" or FNPP.

Plastinated fascia specimens are made possible by the revolutionary process invented by Dr. Gunther von Hagens. Through a unique vacuum process, including gas curing, human tissue is permanently infused with liquid polymers that fix the tissues in a predetermined position creating a permanent anatomical teaching specimen for generations to come.

S110

Fascia of the trunk

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In the last years the cadaverlabs are becoming very popular. Their main purposes are: to improve the anatomical knowledges, to permit the training of complex procedures, to improve the learning curve of new surgical procedures, to teach the ethical approach to dead and cadavers, to evaluate new surgical devices. Indeed many surveys demonstrated that a large proportion of graduating medical students believed that their knowledge of gross anatomy was inadequate for safe medical practice and expressed interest in revisiting the cadaver dissection. Current

solutions to limited open operative experience include the use of simulations, but they do not provide sufficient realism and clinical context to substitute for open experience. Indeed the plastic models, computer-generated images and simulators can't replicate exactly the organ fragility and the planes of dissection. Besides, they reproduce a standard anatomy, and this will compromise the knowledge and understanding of variation required to start practicing medicine safely and competently. At the contrary, students who are able to examine several specimens or are privileged to dissect soon realize that each cadaver is unique. At present, cadavers are the only adequate models for the replication of such procedures. But could exist a medical responsibility for a resident or a surgeon who performed a procedure without an adequate training? Has an hospital to guarantee a sufficient training for its surgeons?

The dissected cadaver remains the most powerful means of presenting and learning anatomy as a dynamic basis for solving problems. The cadaver must not be dismissed as obsolete. Dissection has survived the most rigorous test of pedagogical fitness-the test of time. The student-cadaver-patient encounter is paramount in medical education.

S111

Role of the Stained Plastinated Sections in Understanding of the Complexity of Musculo-Fascial Compartments in a Human Pelvis.

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The lower abdominal compartment and the cavity of the smaller pelvis are reported to be one of the most obscured places of the human body in regards to topographical relations of the fascial sheaths and fascial compartments. Pathomorphological conditions in this area make the situation even more complex. Besides that, the information, provided by CT and NMR images doesn't fulfill requirements for the detailed study of anatomical structures of the region with particular pathological changes in the supporting apparatus of a pelvis. Traditional dissection of fascia sheets (macro- or microscopically) has a relatively high level of errors due, apparently, to manual creation of the man-made layers. Collapsed and dislocated structures in the pelvic dissections may generate the wrong concept and understanding of the topographical anatomy of the region.

In our study, human pelvises were obtained from cadavers donated for plastination and medical research. The pelvis blocks were frozen at -80°C, sectioned in three planes, stained, and plastinated. Staining of the thin sections (thickness of each slice is below 2 mm.) was performed by modified Gomori's trichrome and modified Alcian blue - Van Gieson methods. These staining methods were found to give the clearest visualisation of the topographical interaction of soft tissues, especially muscles and fascial layers with bones and pelvic organs. The stained series of pelvic slices were plastinated following the standard E12/E1, Biodur technique and embedded by the sandwich technique.

Serial sections cut in three planes serve to study specific topographic details. In each series, the three classic planes of sections were chosen so that a spatial reconstruction could be potentially possible.

Horizontal planes the most widely used in clinical examinations. The frontal plane series, technically most difficult is suitable for investigation of the whole pelvic cavity and pelvic floor on the same plane. The sagittal plane series mainly useful to show the relations "organs – visceral fascia" and "visceral – parietal fascia" besides the spatial formations in the anterior-posterior aspect.

The stained series of pelvic slices in three planes clearly show the unique construction and complexities of the fibrous supporting network of the pelvic floor and permit us to follow the pathways and relations of fascial sheaths, ligaments, and muscles in order to visualize pelvic compartments. The details of sections can go down with the resolution down to microscopic level. Therefore this method could be applied for a better understanding of various pathological conditions, related to connective tissues and muscular pelvic floor of the human pelvis. The

unaltered anatomical and morphological information provided as slices can be referred to NMR, and CT images.
The detailed anatomical database, collected with this method makes us understand the structural relationship of the pelvis from a perspective different from the conventional methods. Thus, the series of stained sections are useful in advanced training programs in sectional topography, resident training in CT and NMR. Medical students, residents, and practitioners of radiography, surgery, gynecology, urology, general medicine and physiotherapists must develop a concept of the pelvic region in three-dimensions and must be able to recognize structures viewed in various planes.

S112

Fasciae of the neck

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The cervical fasciae have always represented a matter of debate. Indeed, in the literature it is quite impossible to find two authors reporting the same description of the neck fascia. In this presentation an historical background will be outlined, confirming that the Malgaigne's definition of the cervical fascia as an anatomical Proteus is widely justified. Besides, a topographic and comparative approaches allow to distinguish three different types of fasciae in the neck: the superficial, the deep and the visceral fasciae. The first is most connected to the skin and platysma muscle, the second to the muscles and the third to the viscera. The muscular fascia could be further divided in three layers according with the relationship with the different muscles: an external layer, in relation with the sternocleidomastoid and trapezius muscle, a middle layer, in relation with the hyoid muscles anteriorly, and with the elevator scapulae muscle posteriorly, and a deep layer, in relation with the prevertebral muscles and scalene.
The consideration that the fasciae are organized in the neck as in other parts of the trunk confirms the role of some fascial systems in creating compartments for muscles. The continuity of myofascia among different regions is important in coordinating muscular and proprioceptive activity and would better support the idea of kinematic muscular chains.

Trends in teaching anatomy and histology - current and future

S115

Education in the anatomical sciences: current and future trends

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Innovations in curriculum design, pedagogical approaches, and technology are redefining the medical education environment. In an effort to appreciate how these and other initiatives have influenced education of the anatomical sciences in the United States, we distributed a survey to course directors of gross anatomy, microscopic anatomy, neuroanatomy/neuroscience and embryology. The most significant changes reported by survey respondents were to the number of allocated classroom and laboratory hours and to the percentage of courses which reported being part of an integrated curriculum. In this session these data as well as challenges to collecting survey responses based on these changes will be discussed.

S116

Placing student learning at the core- how 3D printing and ultrasound can help.

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Learning anatomy is a multimodal subject and dissection of donors is a powerful and vital

experience, yet the expansion of knowledge and how doctors are using their knowledge and skills means that dissection alone does not prepare them for practice. Brighton and Sussex Medical also assists students learning through two main modalities: 3D printing and E resources, and using living anatomy and ultrasound sessions. For the 3D printing, 3D body parts are printed from a CT dataset of a donor allow medical students to continue their learning outside of the laboratory. A RCT has shown a rise in student retention when 3D prints were used (p=0.0006). To assess the impact on medical student learning focus groups (n=15) yielded six key themes: model properties, teaching integration, resource integration, assessment, clinical imaging, and pathology and anatomical variation. Living anatomy and ultrasound has been fully integrated into year 1 and 2 of the MBBS medical curriculum in small group teaching sessions (n = 15), that total 12 hours. A questionnaire consisting of 15 questions following each systems-based module in year 1 for the 2014/15 and 2017/18 cohorts showed that students see why ultrasound is relevant to practice, felt it helped them to comprehend the 3D nature of the human body and helped their understanding of surface anatomy. Two focus groups (n=13 students) explored students' perceptions. Thematic analysis highlighted themes of respect and empathy for the patient, and concerns over the impact if no one volunteered. Students also reported the helpfulness of ultrasound for aiding interpreting 3D and radiological images. In summary, as educators we must provide different experiences to enable students to learn and apply anatomical knowledge.

S117

Volumetric Histology - 3D-reconstruction of histological tissue slices for a better functional understanding

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For decades society has learnt about microscopic anatomy using two-dimensional histological section preparations. While the variety of histological staining offer tremendous possibilities to visualize morphological content within the sections, the overall shape of the specimen as well as the close relation of different tissue structures is often not well understood. This is because the two-dimensional point of view allows only limited imagination about the volumetric tissue structures, which in fact could be crucial for a global understanding and diagnosis of the investigated tissues.
The aim of this project is to provide a workflow to create high-quality three-dimensional reconstructions of different anatomical structures based on histological serial sections, to fill this knowledge gap. The presentation demonstrates a state-of-the-art reconstruction workflow and the inherent challenges on the basis of a histologically prepared human tear duct, where the exact function mechanism is not yet fully understood. In addition, several reconstruction results of different specimens are shown, thereby proving that 3D histology reconstruction offers exciting new ways to gain new and better anatomical knowledge.
The methods used included proper consent and approval, compliance with the Helsinki Declaration and approval by the Ethics Committee of the Friedrich-Alexander-University (FAU), Erlangen, Germany.

S118

Cinematic Rendering in anatomical teaching - a new tool for lecturers and students

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Cinematic rendering (CR) technology was developed a few years ago by Dr. Klaus Engel (Siemens Healthcare GmbH) as a medical image visualization technology that enables photorealistic 3D images of the human body. The fascinating highlight of this technology is that existing procedures such as computer tomography (CT) and magnetic resonance

imaging (MRI) provide the raw data for this application. CR can thus be used to produce jaw-dropping images of the human body, not only for clinical but also for preclinical use in medical education. Siemens and the Institute of Functional and Clinical Anatomy at the University of Erlangen-Nürnberg are currently working closely together to develop a platform-independent software application that will enable lecturers and students in anatomical education to use this technology in the future. In this presentation, we generally introduce CR technology using selected examples and report on the current state of development of our future application.

The methods used included proper consent and approval, compliance with the Helsinki Declaration and approval by the Ethics Committee of the Friedrich-Alexander-University (FAU), Erlangen, Germany.

Tumour microenvironment, cellylar and molecular basis of cancer progression

S119

Loss of IIFP induces a luminal to basal transition and triple negative breast cancer in mice

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Cancer stem cell have many similar features with their normal counterparts. However, the regulatory mechanisms of stem cell stemness remain elusive. Here, we find that, a novel scaffold molecular IIFP are significant in maintaining MECs hierarchy. IIFP-deficient MaSC/bCSC cells exhibit a restrained transcriptional drift toward a normal luminal state and increased self-renew ability. IIFP is severely low expressed in human breast cancer cells and associated with poor prognosis. We show that knockdown IIFP induces increasing anchorage-independent colony formation ability In vitro. In mouse models, knockout IIFP induces dysplasia of mammary gland development and triple negative mammary tumors. Following IIFP deletion, MECs acquire a capacity for unlimited propagation and induce tumors. Meanwhile, the deficiency of IIFP in particular increase MECs stemness and weaken the luminal-lineage formation. Furthermore, loss of IIFP results a luminal to basal state and increases the tumorigenic which are also verified in pymt mice model. Mechanism studies show the phenotype of knockdown of IIFP maybe through inhibit NOTCH pathway by increasing DVL2 level in nuclear. Taken together, our findings provide a basis for future delineation of mechanisms that the regulation of mammary gland hierarchy which maybe a potential application for the prevention and treatment of breast cancer.

S120

MiR-31 is a critical epithelial modulator of inflammatory and regenerative signals in human and mouse colitis

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miR-31, a small noncoding microRNA, increases in inflammatory bowel diseases, and is up-regulated during the progression of inflammation-associated intestinal neoplasia. We investigated the mechanism of miR-31 in the progression of ulcerative colitis (UC) and its therapeutic potential in the treatment of a mouse model of UC. Here we found that miR-31 expression is increased in human UC tissues and in DSS-induced mouse colitis. MiR-31 is directly induced by inflammation through NF-kB and STAT3 signaling pathways. During colitis, miR-31 induction attenuates the inflammatory response by directly targeting Il17ra, Il7r and Il116st (encoding Gp130) in the colonic epithelium. Concomitantly, miR-31 promotes epithelial regeneration by activating both Wnt and Hippo signaling pathways. Moreover, we developed a bio-degradable nanodelivery system (OKGM-PS-miR-31) in which miR-31-mimic-loaded

peptosomes (PS) are encapsulated into oxidized konjac glucomannan (OKGM) microspheres. OKGM-PS-miR-31 microspheres are sufficient to delivery miR-31 into colonic epithelial cells, and effectively repress the inflammatory response and promote epithelial regeneration in a mouse model of colitis. In summary, miR-31 functions as a "brake" to suppress the immune response in epithelium through a negative feedback loop while concomitantly promoting epithelial regeneration by directly activating WNT and Hippo signaling pathways. We provide proof of principle that OKGM-PS-miR-31 nanodrugs represent an effective therapeutic strategy for UC. All mouse experiment procedures and protocols were strictly in accordance with the guideline under the Institutional Animal Care and Use Committee of China Agricultural University (approval number: SKLAB-2011-04-03).

S121

CREPT regulates G2/M phase transition via Cyclin B1 transcription

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Cell cycle is tightly regulated by different cyclin-dependent kinases (CDKs) and cyclin-dependent kinase inhibitors (CKIs), which is dys-regulated during tumorigenesis. We have cloned a novel gene CREPT (Cell-cycle Related and Expression-elevated Protein in Tumor) based on a homology screen using p15RS, which contains a RPR domain (regulation of nuclear pre-mRNA, or CID, CTD-interacting domain). Our previous studies revealed that CREPT regulates Cyclin D1 expression by binding to its promoter, enhancing its transcription through RNA polymerase II (RNAPII). CREPT promotes the formation of a chromatin loop and prevents RNAPII from reading through the 3'-end termination site of the gene. In this study, we observed that CREPT and Aurora B are coordinately expressed during the cell cycle in gastric cancer cells. Deletion of CREPT disturbed the cell progression and extended the length of cell cycle, leading to a significant accumulation of mitotic cells. CREPT interacts with Aurora B to regulate the expression of Cyclin B1 by phosphorylating S145 in a well-conserved motif of CREPT. We proposed that phosphorylation of CREPT by Aurora B is required for promoting the transcription of Cyclin B1, which is critical for the regulation of gastric tumorigenesis. Targeting the interaction of Aurora B and CREPT might be a strategy for anti-gastric cancer therapy in the future.

S123

Aberrant expression of NOL12 and its potential oncogenic role in cervical cancer

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NOL12 is a highly conserved nucleolar RNA binding protein (RBP) in vertebrates, playing multifunctional roles in DNA damage response (DDR). Here, we describe an enhanced expression of NOL12 in human cervical cancer, with a primary localization in the cytoplasm rather than in the nucleus and nucleolus. This nucleocytoplasmic shuttling depends on its newly identified nuclear localization signals (NLS), nucleolar localization signals (NoLS) and nuclear export signal (NES). Over-expression of NOL12 promotes proliferation, vitality and migration of HeLa cells, enhancing tumorigenicity in athymic nude mice, while down-regulation of NOL12 by RNA interference inhibits tumorigenesis, inducing apoptosis. Apoptosis induced by NOL12 silencing is correlated to the activity of ataxia telangiectasia and Rad3 related kinase (ATR)-mediated apoptotic response. It is also found that NOL12 dramatically decreases in a protease cleavage dependent manner after UV irradiation or DNA damage agent camptothecin (CPT) treatment, which could be an important cause of DNA damage-induced apoptosis. Our findings suggest that NOL12 could be a novel candidate oncogene in cervical cancer, which may contribute to inhibition of cancer cell apoptosis by regulating DDR.

S124

Src-mediated phosphorylation converts FHL1 fromtumor suppressor to tumor promoter

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FHL1 has been recognized for a long time as a tumor suppressor protein that associates with both the actin cytoskeleton and the transcriptional machinery. We present in this study a paradigm that phosphorylated FHL1 functions as an oncogenic protein by promoting tumor cell proliferation. The cytosolic tyrosine kinase Src interacts with and phosphorylates FHL1 at Y149 and Y272, which switches FHL1 from a tumor suppressor to a cell growth accelerator. Phosphorylated FHL1 translocates into the nucleus, where it binds to the transcription factor BCLAF1 and promotes tumor cell growth. Importantly, the phosphorylation of FHL1 is increased in tissues from lung adenocarcinoma patients despite the downregulation of total FHL1 expression. Kindlin-2 was found to interact with FHL1 and recruit FHL1 to focal adhesions. Kindlin-2 competes with Src for binding to FHL1 and suppresses Src-mediated FHL1 phosphorylation. Collectively, we demonstrate that FHL1 can either suppress or promote tumor cell growth depending on the status of the sites for phosphorylation by Src.

Variation: anatomical constant, clinical imperative, educational dilemma

S125

Evidence-Based Anatomy

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Evidence-Based Anatomy (EBA) is the concept of applying the principles of evidence-based medicine in the field of anatomy. The conduct of systematic reviews and meta-analyses (MA) to anatomical structures would help in assessing their variations with more accuracy. It is believed that the generated weighted values and the systematic approach to anatomical structures would have a substantial clinical impact.

The methodology of conducting anatomical meta-analyses was assessed. Based on 20 anatomical meta-analyses published in the literature, an evaluation of their clinical impact was conducted.

The checklist for anatomical reviews and meta-analysis (CARMA) was updated. Weighted results of the number of slips of each long extensor tendons of the hand showed where to better locate sources of tendon graft from the dorsum of the hand. In reconstruction surgery, the Plantaris tendon demonstrated a better surgical consistency than Palmaris Longus. When compared to clinical MA, interventional cadaveric MA were found to be a better model in assessing potential complications in mini-invasive surgery. Peroneus quartus and peroneus digit quinti muscles are unlikely to be variants of a same structure. Sternal lengths are not reliable to estimate stature from corpses. The fibularis tertius muscle could had played an essential role during the phylogenetic development of the erect bipedal posture and during gait. The frequency and distribution of the sesamoids of the hand and the foot are likely to be linked to the degree of independence of the digits.

EBA offers the possibility of generating more accurate values in relation to anatomical variants. Values such as mean frequency and mean size of anatomical structures could serve as reference values for future research. The clinical impact is shown to be substantial.

S126

Paediatric Anatomy: emerging from the shadows

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The ubiquity of medical imaging has rekindled an interest in paediatric anatomy and challenges the perception that children are mini-adults. A comprehensive understand of paediatric anatomy has important clinical and forensic applications. This presentation aims to provide an evidence-base for clinically relevant paediatric anatomy and to highlight teaching points for medical students, emphasising the current knowledge deficits, secular and geographic differences, and providing an analysis of the continuum of normal from birth to adulthood. A lack of appreciation of the dynamic changes during paediatric development, and its range of normal variants, has been implicated in medical errors. In radiology, for example, an appreciation of normal paediatric variation with age, aids in interpreting medical imaging with a confident determination of normality. While in paediatric polytrauma, which is complex and challenging to most clinical disciplines including orthopaedics, an appreciation of the range of differences with skeletal maturity can minimise error in overlooking sustained injuries and implementing inadequate management. In trauma, children and adult anatomy differs from that of adult patients in both the type of injuries sustained and the management required. Not only is the histological structure of paediatric bone different from that of the adult, but the appearance of metaphysis, sutures and bony features on medical images change with age. Further, while neurovascular injury is frequently implicated in the management complications in paediatric polytrauma, the changes of neurovascular relations with paediatric age, is as yet not clearly understood. There is a need to equip medical graduates with a foundational appreciation of developmental variations in the paediatric population, and to develop accessible point-of-care best practice references. Anatomy and medical imaging are natural bedfellows that can partner to respond to this need.

Anatomical variation in dental practice

Ernest A Jennings[1]

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Anatomical variation in the head has special relevance to dental surgeons as they routinely undertake irreversible surgical procedures and need to be aware of variations. This is becoming increasing relevant as general dental practitioners increase their scope of practice, undertaking implants and other surgical interventions which have an increased likelihood of poor outcomes if an individual's anatomy are not taken into account. The aim of this symposium presentation is to highlight key anatomical variations of relevance to dentists and outline approaches taken to teaching these to undergraduate and postgraduate students.

Given that the prime area of focus for the dental surgeon is the oral cavity it is not surprising that dental curricula focus on variation of osteology and associated soft tissue anatomy of the maxilla and mandible. In the mandible, for example, there is variance in the the position of the mandibular foramen, through which the inferior alveolar nerve enters the alveolar canal. This may impact the efficacy of local anaesthetic injections in as many as a quarter of the population. In the maxilla, an area of interest is the relative proximity of the floor of the maxillary sinus to the underlying alveolar bone of the maxilla. This bone may atrophy with age or disease and the anatomy needs to be taken into consideration when planning extractions or other surgical interventions.

The majority of textbooks provide a sound overview of the anatomy of this area, but focus little on variation. One approach to bridging this gap is to direct students to primary literature, based largely on cadaveric studies.

In summary, this symposium presentation will highlight key aspects of anatomical variation relevant to dentists and one approach to designing a curriculum to cover this aspect of anatomy.

S128

Teaching anatomy beyond the sex binary

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Developments in biology and genetics in recent decades, have caused significant shifts in the understanding and conceptualizing of human biological variation. Humans vary biologically in different ways, including individually, due to age, ancestry and sex. An understanding of the complexities of all levels of human biodiversity is necessary for efficient health care delivery. It has been argued that major steps in teaching medical students about human biodiversity could be carried out in anatomy classes and that it is important that anatomical education absorbs new developments in how biological variation is comprehended. Since the early 1990s biological sex in humans has been vigorously investigated by scientists, social scientists and interest groups. As a result, the binary division in male and female sex has been called into question and a more fluid understanding of sex has been proposed. A cursory look at some of the major introductory and gross anatomy textbooks suggest that anatomy, particularly of the urogenital system, is thought as a male-female binary. Anatomy curricula should adopt a more up-to-date approach to sex including the introduction of the category of "intersex" and present sex as a continuum rather than two sharply divided sets of characteristics. This approach offers a better understanding of the complexity of sex differences and, at the same time, provides students with an improved theoretical framework for understanding human biodiversity in general, transcending the limitations of biological typology. Well delivered, the non-binary approach could play a significant contribution in the formation of competent and responsible medical practitioners and avoidance of problematic practices such as non-consensual "normalizing" surgeries.

S129

Challenges of teaching and learning anatomical variation in postgraduate speciality programmes

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Postgraduate medical training in anatomy is frequently sought by prevocational doctors to assist in entry to competitive specialty training programmes. A strong foundation in anatomical science is critical for safe clinical practice and a requirement for entry into the Surgical Education and Training (SET) programme in Australia. Postgraduate anatomy programmes provide a unique opportunity to review, consolidate and enhance anatomical knowledge. In addition, these programmes should be structured to facilitate the development of research and critical thinking skills with the aim of improving an individual's ability to both recall information and apply it effectively in a clinical setting.

This theoretical work examines the role of anatomical variation as a key aspect of anatomical literacy for postgraduate surgical anatomy education. It draws together some of the latest research to put forward a theoretical framework of best practice in teaching and learning strategies to help students find clinical relevance in their anatomy learning.

There is evidence from the educational literature of strategies that guide students towards deep learning approaches, assisting in the developing positive attitudes to learning and an enhanced ability to apply knowledge within appropriate clinical contexts. This is analysed and applied to current postgraduate anatomy course structures currently available and educationally endorsed by the Royal Australasian College of Surgeons (RACS). The retention and application of anatomical knowledge, and the relevance of anatomical variation, plays a pivotal role in both clinical specialty training and clinical best practice. It is therefore essential that we tailor postgraduate teaching methods to meet the needs of both students' and the training colleges,

and that reflect modern approaches to learning, teaching and assessment of anatomy. No ethical approval for this study was required.

S130

The 50 Shades of Gray's Anatomy: Anatomy Education as a Primer for Student Development of Tolerance of Ambiguity

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Medical students often perceive anatomy as a "dead" science, one that is both complete and certain. Authentic anatomy, however, is comprised of variations, unknowns and ambiguities. Given that ambiguity is also inherent within clinical practice across the spectrum of patient care, anatomy education may afford ripe opportunities to prepare students for developing tolerance of ambiguity (ToA). ToA is a construct describing an individual's response to ambiguous stimuli; in the healthcare environment, low ToA (sometimes "intolerance" of ambiguity) is linked to negative outcomes such as over testing of patients and clinician burnout. Following ethics approval, we explored the impact of anatomy education on medical student ToA using an inductive longitudinal qualitative study. Data collected from online discussion forums during semester and interviews at the end of semesters were analaysed using framework analysis. Stimuli of ambiguity, student responses to ambiguity and factors impacting/moderating students' ToA were all identified within the anatomy education context. Anatomical variation was described as a stimulus for ambiguity in relation to learning from donor dissection and prosections. Appreciation of anatomical variation, however, was more clearly tied to student descriptions of donor dissection, with students describing this as a key difference between learning from donors and learning from textbooks. Some students furthered this discussion by linking anatomical variation with implications for their future clinical practice. Interestingly, anatomy educators impacted student ToA, with didactic teaching approaches having negative impacts. Alternatively, educators highlighting and discussing anatomy-related uncertainties positively impacted students' ToA. Although some students struggled with the concept of ambiguity early in their anatomy studies, over time acceptance of ToA as a clinical competency improved. This research suggests that anatomy education, which highlights inherent ambiguities and variations, has a potentially important role in fostering medical student ToA, and facilitating students' preparedness for practice.

S131

Variability as a core element of anatomical literacy in medical education

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Variation, a flexibility of form and pattern which does not generally hinder function, is the norm rather than the exception in anatomy, and has been documented in all regions and systems of the body. This study explores the clinical relevance of variation as well as new approaches to teaching about variation. Data from published meta-analyses are summarized, showing that clinicians encounter variations on a daily to weekly basis, and that ignorance of variation can lead to serious medical errors. New survey data from clinical and anatomical faculty at medical schools in the United States echo previous findings from surveys of medical residency programs: undergraduate medical education is the best time to introduce concepts of variability, an understanding of normal range variation is important to most areas of clinical practice, and variation is viewed as a key component of anatomical literacy. However, survey results demonstrate that current practices for teaching

variation are diverse, and that best practices do not yet exist for teaching a deep understanding of variation in medical and anatomy education. While an extensive inventory of anatomic variations has been amassed, the information is scattered and challenging to access in a point-of-care clinical or educational context. Two flavors of Just-In-Time Teaching, one where student assessment data drives learning content and another where content is available on-demand at the point of clinician need, are explored as a possible framework to better incorporate variations into pre-clinical and clinical education. A case study is presented showing the application of just-in-time learning to clinical training. The surveys employed in this study were approved exempt by the Colorado Multiple Institutional Review Board.

Exposing it in public; anatomy engagement, communication and outreach

S132

Anatomy engagement – a global study

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Anatomy education is often associated with medical and allied health courses where students learn relevant anatomy over a number of months or years. Recently research and a shift in policy to ensure academic institutions are more accountable to their communities, has shown that there is a growing need and desire for anatomical education to the wider public. The availability and portability of novel teaching resources such as plastic and 3D printed models, as well as innovative imaging software mean that anatomy-learning opportunities can be offered outside of the typical teaching environments. These opportunities are two-fold; educational for those involved and also an opportunity to understand more about what the public know and how this is important for education and health campaigns in the future.

This study aimed to survey the knowledge of the public regarding their anatomical knowledge of multiple organs and structures in the body whilst comparing performance against gender, age, working in healthcare and recent visit to a healthcare professional. Completed answer sheets were scored against a standard answer version and results collated and significance between groups calculated. This study was approved by Lancaster FHM REC.

Results demonstrated a broad variation in what the public know about the anatomical location of structures and organs. Some scored at 100% correct, such as the brain, whilst others were well answered, including the cornea. Organs in the thorax were well answered, but those located in the abdomen were much more variable, with some organs such as the spleen and adrenal glands being answered poorly, with less than 20% placing correctly.

This study demonstrates a diverse knowledge of the public and suggests that public engagement and more formal educational opportunities during childhood may improve anatomical knowledge and the ability of individuals to understand more about their body and their health.

S133

Exposing yourself- the Brighton way

Claire Smith[1], Cj Taylor[1], Sam Wickham[1], Michael Koenig[1], Catherine Hennessy[1], Andrew Dilley[1]

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Brighton and Sussex Medical School has undertaken regular outreach events for the public and widening participation. Since 2017 this has included over 900 participants attending events. These important events serve to demystify the human body and promote a wider understanding

of health and disease. At times though this means pushing boundaries, in terms of what individuals find socially acceptable to discuss and also in terms of the legal framework for anatomy. Events use a range of animal dissection, live ultrasound, home produced virtual reality 360° films (n=27), interactive quizzes, living anatomy demonstrations, augmented reality apps and human potted specimens and osteological material. Each event focusing on a particular area e.g. the brain or 'follow your food'. Feedback has been fantastic "a true WOW event, thanks" or has focused on a specific area of health to them "I now understand why my wrist hurts after typing for too long- there's not a lot of space in there!". Brighton and Sussex Medical School has been dedicated to Widening Participation and as part of its programme 147 'BrightMed' students have received anatomical teaching using Near Peer Teaching using the range of resources above. To continue to support the important activities of public engagement, in 2019 Brighton and Sussex Medical School was awarded its Human Tissue Authority Public Display Licence to enable the public to visit the anatomy laboratory, and for events to use consented human material. Brighton and Sussex Medical School has worked collaboratively with the NHS to have a 'Resident Pathologist' who can help guide the clinical focus of events. The new age for anatomy is not behind closed DR doors but wider engagement and transparency with the public.

S134

Utilisation of body paint as a teaching and engagement tool within medical education

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Over the last decade, the use of art based approaches has become more mainstream within medical education. Art has been used as an enrichment activity to break up the cognitive load of the science curriculum. Additionally, art has been used as teaching tool, particularly in anatomy for areas such as surface anatomy, musculoskeletal anatomy or threshold concepts.

Body painting is one popular tool used within the curriculum, as well as being employed for outreach and public engagement activities. Body painting is a useful adjunct to the typical curriculum. It can be used as a standalone anatomy exercise or in conjunction with clinical skills training. This overlap enables communication skills and professionalism to be developed. Students are able to rehearse and develop their clinical examination scripts, improve their anatomical knowledge and physical examination skills. As with all teaching tools, body painting has advantages and disadvantages which must be weighed up. Implementation must be research and benefit driven, not norm driven.

The eye-catching nature of the body painting lends itself to use within the public arena. It is a mechanism by which anatomy can be taught and demonstrated at a basic level, but in an unintimidating and fun manner that is suitable for all ages.

Lately, anatomical body painting has evolved to use an even more striking medium, that of Ultra-Violet (UV) paint. UV provides a wet and therefore more visceral look to paintings, coupled with the vibrant fluorescence. It is visually striking and makes an excellent addition to the toolkit of any anatomy educator. UV paintings are spectacular when used on moving models and exhibited in darkness. The glowing paint on the muscles present as if showing muscle tension. Such painting activities can be used for more functional displays such as our well-publicised UV yoga and fitness demonstrations.

S135

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As scientific fields have become more complex in the 21st century, some Americans have given up trying to understand what we do, leading to science illiteracy. Although scientists have reached consensus on many issues, such as climate change accelerated by humans, and evolution, the public and (American) elected officials have not always accepted this consensus. According to the Pew Center, there is a wide gap

between scientists' and the public's perception of how science is used to inform government policy. Without expert voices communicating science to the public and policy-makers, fields like healthcare, climate science, and evolutionary biology—all fields that are inextricably linked to anatomy—have been overrun with conspiracy theories and misinformation.

The timing is right to make science communication a fundamental part of doing science. And to do that, we must train our students/faculty in the skills necessary to be effective communicators. Over the last several years, the American Association of Anatomists (AAA) has prioritized professional development in science communication for researchers, educators, and practitioners at its annual meeting. Furthermore, AAA recently adopted a new strategic plan which brings science communication front and center, where the public is engaged through the promotion of anatomical sciences. To support this new science communication initiative, AAA will host its inaugural Science Communication Boot Camp (SCBC) on the campus of Indiana University School of Medicine in Indianapolis in July 2019. This three-day program brings participants together to learn effective communication skills from the faculty of the Alan Alda Center for Communicating Science and from representatives of the Federation of American Societies for Experimental Biology science policy staff. This talk will report on the SCBC program and demonstrate some of the hands-on activities employed. This study was granted exempt status by the Institutional Review Board of Indiana University School of Medicine.

S136

Anatomy for Every Body: Teaching Through Television

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Anatomists create and communicate anatomical knowledge. We discover new content through research, and deliver it at conferences, publish scientific articles, or teach it to students. However, the problem with these venues is that we are disseminating it only to a select group of colleagues/students. The lay public does not attend scientific conferences, nor do they read highly technical scientific journals. Therefore, the very people who funded our research grants (via donations or taxes) are not informed about our discoveries, thus contributing to global scientific illiteracy. Anatomists can address this through outreach education. Arguably one of the best methods is television, as it reaches millions of viewers. It engages the public to explore and embrace the wonders of anatomy within the comfort of their home. This presents a special challenge precisely because information is channelled directly into a family's living space for all ages to see. Unlike the cinema, a child's exposure is largely left to parental discretion. It is difficult to know how much graphic material to show: too little limits the appeal, but too much precludes "prime time" airing. Anatomy can be sensitively presented if "gore" is minimized while structural beauty and function are emphasized. Filmmakers are challenged with explaining complex concepts on a level acceptable to a lay audience. Simple explanations can be made elegant, particularly when paired with animated graphics or live film footage. Passionate anatomy educators should be encouraged to participate, as they make ideal presenters. Success can come from framing educational content within an engaging plot, and not deleting scenes containing unexpected moments (humorous incidents, excitement of a discovery, or tension over a mishap). These dramatic moments increase a show's appeal. Successful documentaries merge education with entertainment ("edu-tainment"). Anatomy is an ideal subject for television because it is visual and personal (we all have it).

Understanding anatomy through embryology

S137

Making a functional ear: integration of external, middle and inner ear during development

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Our ears are an integrated system with an external ear (outer auricle and ear canal), middle ear to conduct sound across an air filled space, and inner ear where the hair cells register sound and send messages to the brain. All parts of the ear must link together to provide a united system for sound conduction, however, different parts of the ear form at different time-points and from different tissues during embryonic development. These different parts of the ear, therefore, need to signal to each other to coordinate their development.
In some individuals this signaling is disrupted and parts of the ear fail to form and join together resulting in deafness or hearing loss, affecting more than one part of the ear. We only have a fairly rudimentary understanding of how the different parts of the ear talk to each other during development and define each others anatomy. It is essential, therefore, to study the ear as an integrated system rather than investigating each area in isolation. Here we use a two-pronged approach to understand how the ear as a unit develops, following ear development in mouse and human embryos, and in patients with defects in their external and middle ears. Focusing on external-middle ear interactions, we highlight the timing of when different parts of the ear signal to each other, and the role of key signaling pathways such as Fgfs (Fibroblast growth factor), Bmps (Bone morphogenetic proteins) and Hh (hedgehog) in coordinating development. Home office and ethical approval was provided for this study. Human embryos were provided by the Human Developmental Biology Resource.

S139

Formation of a branching network: the role of clonal competition in murine salivary gland development

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Branching morphogenesis is an iterative process by which a simple epithelial placode (thickening) is finally fashioned into a complex ductal network. This allows the efficient packing of a large surface area of epithelium into a small volume to maximise metabolic exchange- making it a crucial feature for the correct embryological development of many glandular organs. Despite our increasing knowledge of signalling pathways regulating branching little is know about the cellular events that happen during the formation of the branching network. How do cells differentiate along the branching network? Can cells with favorable mutations outcompete its neighbors? And how can this change the final outcome of the branching structure?
To answer these questions, we have developed a modified version of the confetti mouse model that enables labelling both wild type and mutant cells within the same tissue. Similar to the confetti this mouse line inducibly expresses 4 different colours (red, yellow, green, cyan) in a random manner. However, cells expressing the red fluorescence constitutively activate the KRas pathway that plays a key role during branching morphogenesis. Recombination was induced clonally specifically in the epithelium using the tamoxifen inducible K14creERT. Interestingly although wt cells extend only into the last few generations of the branching tree, red cells with KRasG12D expand in entire lobules. Further examination with single cell RNA-seq will unravel

the signaling pathways that give KRasG12D expressing cells a higher clonal advantage.
All experiments were performed according to home office guidelines using schedule 1 approved culling methods.

S140

Ectodermal interactions in vertebrate pineal organ development

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The pineal organ is one of the circumventricular organs of the vertebrate brain and a neuroendocrine gland in the roof of the third ventricle. It regulates circadian and circannual rhythms through the cyclical production of melatonin which is modulated by environmental exposure to light. Pinealogenesis has been studied as a paradigm for the emergence of brain asymmetries and phylogenetic photoreceptor diversity, but how pineal progenitors are specified at early stages of neural development remains comparably unexplored. Classic fate mapping studies in amphibians and birds suggested that pineal progenitors are found at the lateral border of the anterior neural plate. Using gene expression and fate mapping experiments in zebrafish and chick, we show that a subset of pineal progenitors originate from the non-neural ectoderm. Experiments in early gastrula stage zebrafish embryos targeting the dlx gene family (encoding transcription factors that are essential for the specification of the pre-placodal ectoderm) demonstrate that this non-neural contribution to the pineal organ is placodal. We also provide evidence that Fibroblast Growth Factors position the pineal progenitor domain at the neural plate border. Our work suggests an underlying similarity in the formation of the pineal organ, the pituitary gland and the eye, and it raises the possibility that neural/non-neural ectodermal interactions are more generally required for the acquisition of neuroendocrine fates. (The animal experiments have been authorised by the KCL Ethic Review Committee under the HO licence 70/7577.)

S141

The significance and numbering of the pharyngeal arches in amniotes.

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The pharynx is a complex region of the vertebrate body that is involved in numerous critical functions including feeding and respiration, as well as having immune and endocrine roles. Developmentally this territory has its origins in a series of bulges found on the lateral surface of the head of vertebrate embryos; the pharyngeal arches. In many vertebrate clades, this embryonic segmental organisation is translated into the later functional anatomy and is evident in the serial arrangement of the gill bearing arches. However, with the evolution of the tetrapods the pharynx underwent significant change; in post-metamorphic amphibia and amniotes, the branchial skeleton is lost and the larynx forms and the segmental nature of the pharynx is lost from the adult form. Furthermore, there was a reduction in the number of pharyngeal arches. These alteration to the anatomy reflects the fact that the posterior pharyngeal arches are extensively remodelled during later phases of development in amniotes. In this contribution, I will discuss the development of the posterior pharyngeal arches in a range of vertebrate embryos. This has allowed us to highlight the changes that have occurred to the development of the pharynx with the evolution of the amniotes. This work is of importance as it suggests that we need to re-appraise the significance of the pharyngeal arches for later anatomy and reconsider how these segments are numbered.
All necessary ethical approvals for working with the different vertebrate embryos have been obtained.

S142

Understanding anatomy through cell-level embryology

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Anatomical structures are often explained as the result of gene action but there is a widespread and often deep knowledge gap between genes and anatomical phenotype. This gap is filled by analysis of the cellular and signalling processes that mechanically construct tissues and organs. This is illustrated by progress in understanding the development of ectodermal organs (teeth, hair follicles, mammary glands, salivary glands, etc.) in terms of cell behaviours, molecular signals and the tissue mechanics. The formation and invagination of placodes (epithelial thickenings) and their subsequent morphogenesis requires relatively few specialised cell behaviours (including "vertical telescoping" and "canopy contraction") with anatomical diversity arising from different but simple combinations thereof. These behaviours and an even more elemental and global framework for understanding morphogenesis through cell behaviours will be presented.

S143

Adding humanistic values to anatomy education

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Anatomy used to be an unpleasant and dark side of medical education. Dissected bodies were unnamed specimens used solely for the exploration of structural knowledge. Alienation of affection from the dissected could affect students' attitude towards their future patients. This contradicts the medical educational aim of training caring and empathic professionals. To change the image of the anatomy program and to enhance its significance in medical education, an alternative approach is to treat the bodies as persons rather than specimens through interaction. Donors are regarded as silent mentors or altruistic role models with names and life stories. Trainees connect to the donors by visiting surviving families and participate, with families, in ceremonies at the beginning and end of the dissection course. This interaction enhances the appreciation of the donation and incites in-depth introspection in trainees to be caring professionals. In addition, it comforts surviving families and helps to reduce public resistance to body donation. In our experience, such interaction connects the learners to the altruistic philosophy of body donors and surviving families, hence enriches gross anatomy teaching with cultivation of empathy, which is fundamental to modern medical education. This renovated teaching program started in Tzu Chi University in eastern Taiwan in 1996, and soon spread to all medical schools in the island. The philosophy of this humanistic approach is now incorporated in the anatomy program in many medical schools particularly in Asia.

Anatomic education in Asian region

S144

Current situation and reformation in Chinese anatomy education

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As one of the most important basic medical curriculum, Anatomy education is facing more and more challenges in China. Teaching hours are cut down and curriculum integration are two main impact. Compared with most of the medical college around the world, Chinese medical university has large numbers of medical students, so different university has their own syllabus according to different major. For those class with the students less than 100, integration course was used in two ways: one is the only the basic medical courses were integrated, the other way is integrated both clinical medical courses and basic

medical courses together. PBL and Flipped classroom were introduced into this integration course. For those class with more than 100 students, traditional courses including: systematic anatomy, regional anatomy, sectional anatomy, human anatomy, oral and maxillofacial anatomy and neural anatomy were taught to different students depending on their majors. Now more and more universities pay close attention at humanistic care for body donors, which students usually call them “body mentor”. In many universities, the medical students organize various activities to show their gratitude to body donors and memorializing them. These commemoration activities were widely reported by media and encouraged more people to register as body donors. The aim of education reformation is to make young students into excellent doctors, reformation of anatomy education should with the development of modern medicine.

S145

Regional anatomy and neuroanatomy books, full of schematics and mnemonics

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In order for the medical students to learn regional anatomy with comfort, a cheerful book dealing with concise contents is needed. So the authors have elaborated a regional anatomy book fitting for the purpose. In order to reduce the amount of the book, anatomical facts essential for cadaver dissection were mainly selected. Not only the simplified figures but also the comics depicting mnemonics and humors of anatomy were contained. The electronic book (a PDF file) titled “Memory Booster of Regional Anatomy” could be downloaded from the homepage (anatomy.co.kr) without payment.

By the way, most medical students perceive neuroanatomy as the terrifying subject because of the vast amount and difficulty of contents. The representatively overwhelming contents are the extremely complicated neuronal connections. To relieve their neurophobia, the authors have made the same sort of neuroanatomy book containing the simple and consistent rules rather than the exhaustive details. The trial was approved by the Elsevier publishing company, which decided to physically publish this neuroanatomy book in 2020.

Hopefully, the presented books would function as a pleasant resource to help the medical students learn regional anatomy and neuroanatomy. Simultaneously, these would inspire other anatomists to produce their own books with distinct characteristics.

S146

Homepage to distribute the anatomy learning contents including Visible Korean products

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The authors have operated the homepage (anatomy.co.kr) to provide the learning contents of anatomy without charge or registration. The purpose of the study is to encourage other anatomists to utilize their own homepages for distributing learning contents, so that the anatomy can be understood better by various users.

From the homepage, all Visible Korean products including sectioned images, volume models, and surface models of cadaver can be downloaded. The sectioned images accompanied with segmentation data can be used for learning sectional anatomy to interpret computed tomographs and magnetic resonance images. The volume models reveal the actual color of the cadaver, while the surface models can be rotated freely. The realistic images, which will give rise to the interest in anatomy, can be interactively manipulated with typical personal computer.

The various anatomy comics (learning comics, comic strips, etc.) are approachable. Visitors can obtain the regional anatomy book with concise contents, mnemonics, and schematics as well as the simplified dissection manual.

Medical students, health allied professional students, and even laypeople are expected to utilize the easy and comforting anatomy contents. It is hoped that other anatomists successively produce and distribute their own informative contents.

The hand, the eye and the mind: multisensory approaches to learning anatomy using visual arts

S147

Dissection of a painting – Rembrandt: The Anatomy lesson of Dr. Tulp

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The Anatomy lesson of dr. Tulp painted by Rembrandt is one of the most well-known anatomy-related paintings. Dr. Tulp, or as also known, the Dutch Vesalius, was a famous medical professor and chair of the guild of surgeons in Amsterdam. Students of the course "Borderline Anatomy", delivered at the University of Pecs Medical School, explore anatomy-related perspectives of different disciplines. They listen to lectures about anthropology, paleontology, veterinary anatomy, art, body modifications or the anatomical relations in armed forces. In the lecture about this painting, they learn about the painting itself, how dissections were organized in anatomical theaters, who was in the painting and why, and what was exactly shown. At the end, we discuss the anatomy of the forearm and hand, and compare real structures with the ones depicted by Rembrandt. Students enjoy the investigative insight of what is right and wrong in the picture and what structures are missing from the painting. The combination of art, history and anatomy provides a novel demonstration of how anatomy knowledge can be used in many different fields of art and science. At the end of the course students are required to prepare a presentation of any anatomy-related topic. Alternatively, they can submit an interview with a medical doctor or university professor, who is engaged in any other activity of art, sports or history.

S148

The symbiotic relationship between anatomy and art – exploring the evidence for enhanced learning

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A growing body of evidence suggests visual-arts-based interventions enhance the learning experiences of students studying anatomy. However, our understanding of the role of artistic pedagogies in students' anatomy learning remains limited. This is primarily due to the lack of a systematic analysis assessing the body of current evidence regarding the different types of visual-arts-based interventions and their impact on the knowledge, skills, and attitudes of students studying human anatomy. At a time when there is increasing focus on the integration of medical humanities into health and science education, it is imperative to understand the visual-arts-based strategies available and the effects they have on the delivery and acquisition of knowledge, skills and attitudes in anatomy education. The aim of this presentation is to provide a systematic review and analysis of the different types of visual-arts-based methods and the evidence for their use in the study of the anatomical sciences at higher education institutions.

S149

Collaborative optimisation of focused anatomy observation and drawing techniques for enhancing cognitive memorisation

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Having developed our approaches independently in South Africa and the UK, we will present key principles and components which underpin the theoretical basis and practical implementation of our distinct art-based anatomy learning methods 'Hapticovisual Observation and Drawing' (HVOD) and 'Observe-Reflect-Draw-Edit-Repeat' (ORDER).
While sight is predominantly used to observe anatomy, touch can yield additional and valuable information about the three-dimensional form of anatomical features. HVOD employs detailed visual and haptic observation, coupled with simultaneous gesture drawing. Kolb's cycle of experiential learning provides ORDER with a framework for collaborative and active observation, visualisation and reflection.
We have previously shown that ORDER can improve anatomy knowledge in practical and virtual environments and that HVOD is effective for enhanced anatomy observation, cognitive memorisation, perceptual understanding and spatial orientation. Major advantages of ORDER are logistical efficiency and implicit integration into anatomy learning. Brief but effective anatomy learning activities that are translatable to self-directed online tutorials are highly beneficial within the context of congested medical curricula. In contrast, HVOD is offered to medical professionals and students at the University of Cape Town via a one-day, university certificated, anatomy observation and drawing continuing professional development course. HVOD has strong theoretical, pedagogic and neuroscientific underpinnings and once learned, this observation method can be applied by both students and healthcare professionals.
Based on our findings and experiences, we will describe how we aim to reconcile the perceptual understanding and cognitive memorisation gains of HVOD with the theoretical and logistical advantages of ORDER. Furthermore, we will describe the development of our combined and collaboratively developed art-based learning approach in terms of delivery to a global audience via a massive open online course (MOOC).

Research studies have been performed with ethical approval and with the understanding and consent of participants.

S150

Integrating anatomy and art – finding connections

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This two-part presentation will allow the audience to experience some of the innovative approaches to teaching anatomy used in 'The Exquisite Corpse', an intensive course initiated at the Australian National University offering a contemporary model for the interdisciplinary study of art and anatomy. The course is designed and delivered by anatomists Alexandra and Krisztina and artist and lecturer Elisa, who are all advocates for a truly integrated approach to learning both anatomy and art, with balance embedded in every aspect of the curriculum, its delivery and accessibility to students from across the arts and sciences.
Ways to investigate the world with curiosity and open-ended speculation are the essence of both art and science. Experiencing learning anatomy through the physical practice of drawing and the manipulating of materials helps embed learning by fostering a sense of awe at the specificity and complexity of often seemingly simple anatomical structures.
Guided demonstrations will be given in specific approaches to observational drawing and modelling forms which are designed to breakdown conventional thinking about the value visual arts processes offer anatomy, shifting the focus from outcomes seeking perfect correspondence, to processes which promote confidence for experimentation and exploration as a means to building knowledge acquiring skills.

Insights into therapeutic success and challenges in motor neurone diseases

S152

Transcriptional profiling of differentially vulnerable mouse motor neurons reveals modifier of motor neuron disease

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The term "motor neuron disease" encompasses a spectrum of disorders in which motor neurons are the primary pathological target. However, in both patients and animal models of these diseases, not all motor neurons are equally vulnerable, in that while some motor neurons are lost very early in disease, others remain comparatively intact, even at late stages. This is seen in both adult motor neurons disease (e.g. amyotrophic lateral sclerosis [ALS]) and childhood motor neuron disease (e.g. spinal muscular atrophy [SMA]). This creates a valuable system to investigate the factors that regulate motor neuron vulnerability. Here, we aim to use this experimental paradigm to identify transcripts which are important in regulating motor neuron degeneration and transcripts which are potential neuroprotective modifiers. We have compared the transcriptome of motor neurons from mouse models of SMA and wild-type mice. We first show that there is a selective upregulation of the P53 signalling pathway in vulnerable motor neurons and reducing P53 levels can ameliorate neuromuscular junction pathology. In order to identify neuroprotective modifiers, we have also compared our transcriptional screen to other published works on motor neurons which are differentially vulnerable in ALS, and reveal a short list of common transcripts. We show that over-expression of at least two of these transcripts can extend life span, increase weight and decreased NMJ pathology in a mouse model of SMA. In summary, we show that transcriptional profiling of differentially vulnerable motor neurons can give important insight into the molecular mechanisms of motor neuron degeneration and identify neuroprotective modifiers.
All experiments were performed in accordance with the UK Home Office, and all animals were killed using an overdose of inhalation anaesthetic.

S154

Modelling Motor Neuron Diseases Across Animal Models (zebrafish and mouse) for Therapy Development

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Motor Neuron Diseases (MND) describe a range of rare neurodegenerative disorders characterised by progressive muscle weakness resulting from of upper or lower motor neurons. Spinal muscular atrophy (SMA) is a childhood-onset MND caused by mutations in the SMN1 gene, while amyotrophic lateral sclerosis (ALS) is an adult-onset MND with multiple associated genes but no single genetic cause. Due to complex genetics and unknown disease pathways, modelling ALS for therapy development is challenging. We previously used zebrafish to model SMA through knockdown of the Smn gene, which produces a shorter, excessively branched motor axon phenotype and impaired swim behaviour in zebrafish. These phenotypes could be rescued by targeting bioenergetic pathways, which are dysregulated in motor neurons innervating muscle groups vulnerable in SMA. Dysregulated energy metabolism is linked to both SMA and ALS, so targeting these pathways could also be therapeutic in ALS. To achieve this, we created models based on two genes associated with ALS: C9orf72 and TARDBP (TDP-43). C9orf72 mutations

are the most common genetic variant in ALS patients, and while TARDBP mutations are rare, most ALS patients' motor neurons contain TDP-43 aggregates. Using mutant TARDBP RNA overexpression or C9orf72 expression knockdown we can model different genetic backgrounds of ALS, which creates a similar phenotype to Smn knockdown, with shorter, more branched motor axons. We are investigating whether the axonal phenotype in ALS models can be rescued by targeting energy metabolism, as seen in Smn knockdown. Meanwhile, we are assessing the effects of these genetic and therapeutic targets on mouse SMA models. We have previously shown that therapies developed in zebrafish can partially rescue the SMA phenotype in mice. By taking successful targets and compounds from zebrafish models into mouse models of MNDs we hope to provide a more reliable therapy development pipeline for MNDs.

S155

Identifying novel regulators of childhood and late adult onset MNDs

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The term "motor neuron disease" (MND) describes a family of progressive, degenerative, and largely fatal diseases in which the motor neuron is the primary pathological target. While some MNDs are definitively genetic in origin, such as the childhood-onset disease spinal muscular atrophy (SMA), others, such as most forms of amyotrophic lateral sclerosis (ALS), are considered either "sporadic", or are else linked to one or more of a handful of disease-associated genes identified within the past two decades. Increasing evidence suggests that these distinct pathological triggers may converge upon common cascades to yield a unifying phenotype of neurodegeneration, with particular vulnerability of the synapse.

We therefore have performed a comparative study between the synaptic proteome of mammalian models of distinct childhood- to adult-onset MNDs to identify conserved pathways. We have then extended our comparative approach to track putative modifiers in other models of neurodegenerative conditions including genetic forms of childhood dementias. This has yielded a list of potential regulatory molecular candidates which we are currently assessing via genetic manipulation in Drosophila to determine which pathways warrant mechanistic investigation back in vertebrate MND models. Furthermore, we have distinguished between regulatory candidates that dictate a universal degeneration-versus-protection response, versus those which appear to be members of cascades unique to specific genetic insults within the neuron. Ultimately, this cross-disease, cross-species approach aims to identify novel therapeutic targets whose utility to moderate neuronal stability would not be restricted to a single form of these devastating conditions.

S156

Defects in retinal vasculature and neural cells mirrors and models spinal cord defects in a mouse model of severe Spinal Muscular Atrophy

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Spinal Muscular Atrophy (SMA) is a childhood neuromuscular disorder caused by the homozygous deletion or mutation of the Survival of Motor Neuron 1 (SMN1) gene. Whilst lower motor neurons are considered the primary target of this neurodegenerative disease, the ubiquitous reduction of SMN also causes multiple systemic pathologies. Our previous work has shown

significant defects in skeletal muscle vascularity and in the development of capillary beds in the spinal cord of SMA mice, the latter leading to significant functional hypoxia and defects in the blood brain barrier. We suggest that vascular defects may be a contributory factor in multiple systemic defects. To address this we have utilised the mouse retina, where angiogenesis is purely post-natal, as a model to explore the development of angiogenic defects and their association with SMA pathology.

We report that vascular development is severely disrupted in the severe 'Taiwanese' mouse model of SMA, with deficits in vascular density, branching, endpoint number, lacunarity and outgrowth from the optic disc, at multiple stages of development. Importantly, this paucity is not caused by degeneration of blood vessels. Further, we see no differences in the pre-existing hyaloid vascular network, suggesting that embryonic angiogenesis is normal. Analysis of the underlying neural retina at a late-symptomatic stage reveals a reduction in retinal thickness, due to decreased: retinal ganglion, horizontal, amacrine, and photoreceptor cells. This is reflected in abnormal retinal ganglion cell axons. Interestingly, the significant microgliosis present in mid- and late-symptomatic mice suggests that neuroinflammation may be key element of CNS pathology.

Whilst the mechanism that drives these pathologies remains unknown, the similarities between motor neurone and retinal ganglion loss, in association with vascular defects, is striking. This may provide insight into the role of functional hypoxia, as a direct result of vascular insufficiency, in SMA pathogenesis.

S157

The Importance of Understanding Non-neuromuscular Pathologies in mice in the Development of Therapies for Spinal Muscular Atrophy

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Spinal muscular atrophy (SMA) is the leading genetic cause of infant mortality. A homozygous deletion or mutation of the SMN1 gene results in disease-causing, low levels of the ubiquitously expressed Smn protein, which impacts a wide range of essential cellular processes. In addition to the well-characterised expression of Smn in neuronal tissues, many non-neuronal tissues also demonstrate high, early postnatal expression of Smn protein, suggesting its importance during development.

Previous investigations of severe disease models have consistently revealed abnormalities in numerous tissues, including significantly decreased capillary density and collagen IV dysregulation. Here, we investigated the effects of Smn deficiency on renal development in the 'Taiwanese' mouse model of severe SMA (Smn-/-;SMN2tg/0) and heterozygous control littermates (Smn-/-;SMNtg/0). Mice were sacrificed by schedule-1 intraperitoneal injection in accordance with the United Kingdom Home Office Animals (Scientific Procedures) Act 1986. In addition to significant deficits in nephron endowment, we demonstrated several conserved pathologies with other organs, including significantly decreased microvasculature, dysregulated collagen IV and a decrease in kidney-specific, glomerular integrity marker nephrin, using immunohistochemistry and western blotting techniques. This consistent pathology in multiple, diverse organs may indicate significant but unknown roles for the Smn protein.

Many pathologies have been defined in mouse models alone, with little data available to enable understanding of possible effects in patients. As new therapeutics significantly prolong SMA patient lives by treatment of neurological deficits, it is important that the full extent of abnormalities resulting from low Smn levels is understood. It is highly possibly that further pathology may manifest as patient survival increases. Delayed onset of pathological features may be of particular relevance with relation to decreased nephron endowment, which could result in significant renal stress as patients grow and blood volume increases. We are now investigating to what extent systemic pathologies occur in SMA using patient post-mortem tissue.

Brave new E-world! The promise and pitfalls of digital learning resources for the anatomical sciences

S158

E-Learning, CAL, TEL - What do they all have in common?

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Over the last decade anatomy education has continued to undergo a fundamental shift in its approach to curriculum delivery that has seamlessly coincided with the increasing availability and sophistication of modern technology. This approach to innovation and curriculum integration, however, has not been met with a concomitant increase in the number of discipline-specific pedagogical research outputs examining the efficacy of such interventions. This symposium presentation will provide an overview of the sociocultural factors that have influenced the introduction of such technology-based resources, which include: sophisticated learning management systems, massive open online courses, tablet and smart phone applications, podcasts, screencasts, eBooks, social media, and the latest augmented, virtual and mixed reality resources. This ever-changing landscape has led to many conclusions being drawn on the behaviour, inherent abilities and belief that our current student cohorts are in some way significantly different. This leads to the questions: are the students we teach today unique in their specific learning styles, or ability to operate digital technology, or exhibiting unique approaches to learning? Are they fundamentally different to those students who were previously taught? Through the prism of critical advocacy, this presentation will present an evidence-informed approach to curriculum design and technology utilization, which draws on the existing literature and empirical data from educational research, the fundamental belief that anatomists are in a unique position to know their curriculum, and an understanding of the specific cohort that is engaged in your own institution.

S159

When Students Choose E-learning Resources - The Importance of Ease and Convenience

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E-learning resources are popular with today's students. How students choose their favorite e-learning tools has not been investigated in detail and is not well understood. The popular SecondLook™ (SL) Histology e-learning self-review tool was offered in three different formats to students participating in two histology courses at the University of Michigan (CDB450/550, DENT510). The SL formats included downloadable PowerPoint files, an interactive website, and a mobile smartphone/computer tablet application (app). Identical in content, each format had specific advantages and disadvantages with respect to compatible devices, user features, and access limitations. Upon the conclusion of their courses, students were surveyed about their format choices, usage patterns, and reasons for their selection. Only 3 out of 213 participating students (91.4% participation rate) reported not having used the SL resource. Many students (46% CDB450/550, 64% DENT510) tried only one resource format, with PowerPoint being the most popular final choice (56% CBD450/550, 64% DENT510). Although the interactive website and mobile app offered several user-friendly features not available within the PowerPoint files, they only garnered ~20% final popularity. "Convenience," "larger screen," and "easy to use" were given most often as reasons for students' PowerPoint software format choice. The flexibility of time and place to use the resource and availability of features were also named as factors in the format selection. The access to a mobile learning tool enticed some students to use this resource in distractive environments. It also encouraged some students to forgo other learning resources, specifically textbooks and the course website. These results suggest that today's

students are in fact less motivated to actively seek out novel, high-tech learning resources than commonly believed and instead often select easy to use and convenient review tools with which they are familiar. The study received an exempt status from the University of Michigan IRB (HUM00127275).

S160

Online Learning and E-Learning tools: Implementation and Effectiveness

Kem Rogers[1]
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Over the last decade my team has examined the impact of "modern" teaching methodologies as compared to traditional delivery methods. Our studies have focused the effectiveness of a variety of specific E-Learning tools at both the experimental level and in the real world. Our studies have challenged many of the assumptions made regarding the appropriateness of these tools, resulting in data that supports the use of virtual classrooms, while showing that some E-Learning software tools are not an effective substitute for hands on learning.
We have developed two fully Online courses with laboratories in Systemic Human Anatomy and Histology and sought to determine if student preference and performance are influenced by the delivery method (Face to Face vs Online). Our findings suggest that students can achieve the same assessment scores (adjusted for prior student performance) irrespective of delivery method, however, students prefer didactic lectures in an Online format while preferring laboratories be delivered Face to Face. In the modern world of Learning Managements Systems, where all materials including lecture notes and slides are posted for students to examine on their own, we found that attending lectures was not necessary to achieve a passing grade in the course. However, we found that attending a lecture did improve performance on questions related to that lecture, but seeing a lecture more than once (ie a recording) did not influence performance at all.
We have also examined the effectiveness of anatomical E-learning tools, when compared to traditional anatomical specimens, in terms of student performance as it relates to spatial ability and recall. Evidence shows that software based E-Learning tools, including those that support students with low spatial ability, are not as effective as traditional anatomical specimens. However, spatial ability is positively correlated with performance when learning from 3D specimens, and students with low spatial ability require instruction on both sides of the body to effectively learn anatomy. It is interesting to note that textbooks, plastic anatomical specimens and simulation limbs usually only represent of one side of the body, and not the other: this can hamper learning in individuals with low spatial sense.

This work was approved by the Human Ethics Review Board, Western University, Canada.

S161

Digital strategies for anatomy education that augment and extend the educational experience

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Anatomy education is evolving and the emergence of powerful digital technologies affords educators with the unique opportunity to re-think our approach to education. Previous research has shown that the so-called gold standard for anatomy education, dissection, may not be as powerful as we once thought when it comes to the anatomical understanding of the human body in evolving curricula with less time devoted to the anatomical sciences. Emerging technologies allow us to present 3D anatomical datasets in new contexts and allow for integration and interactivity that was previously not possible. The question for educators now is how to gauge this potential and how to determine which approach to use for which content and context. Augmented and virtual dissection tools have their

advantages, but also their pitfalls – we need to find a pedagogical approach to the anatomy classroom that meets the needs of modern, integrated curricula and a new generation of learners. The extended realities (xR) can augment the classical approaches with virtual experiences – it will be the mindful determination of what comprises a quality experience are and what the impact is on our learners. Rather than providing answers, this presentation will provide examples and spark a conversation on how we choose the right medium for our message.

S162

X-Reality on a Budget: Development and Testing of the Virtual Reality Bell Ringer

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Computer-based anatomy resources are used by many students, however they are not often stereoptic and stereopsis is crucial for effective education in anatomy and they are not of actual specimens. In 1962 Dr. D. Bassett published 1,550 stereo pairs of outstanding prosections in collaboration with W. Gruber the inventor of the View-Master. The picture reels were purchased by many anatomy departments, but their widespread use was hampered by practical issues and largely abandoned. We developed an inexpensive, 3D smartphone application to display the Bassett collection for teaching and testing anatomy that we termed the Virtual Reality Bell Ringer (VRBR). The iOS and Android compatible app allows the stereo pairs to be displayed on the smartphone and virtually pinned for bell-ringer quizzes (a.k.a. objective structured practical exams). Navigation within the app and image zoom are accomplished by using simple movements of the headset. A custom Google Cardboard VR device (I AM Cardboard V2®; $8/unit) for viewing the app was given to each of 975 students in the course. The app was developed specifically to support the laboratory component of an introductory, undergraduate, two-semester anatomy and physiology course. To that end 5 or more images for each of the 12 anatomy labs were included in the app. VRBR questions were provided on the CMS and the students were surveyed about their use of the app. In the first semester each optional VRBR quiz was attempted by 32-45% of the students for a total of 1056 quizzes attempted. These attempts were normally within a few days of mandatory, physical bell ringer exam. In the second semester VR was used in the final bell ringer exam and quiz attempts rose to 1355 though attempts were still within days of the exam. Qualitative feedback indicated that the students felt the 3D quizzing was useful but awkward.

S163

Inclusivity in Anatomy Education: Working with Students as Partners in the development of E-Learning

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Although it is now common for tutors to develop their own educational resources, there are some major advantages to partnering with students to co-create them. The benefits are mostly consistent with the face to face element of near peer teaching, the most significant of which is the evidence suggesting that the congruence factors are indeed transferable to e-learning.
At the University of Southampton UK we have extended our peer assisted learning programme with the development of screen casting techniques to supplement the learning of head & neck and clinical neuroanatomy. We have explored, through qualitative methods, the aspects of peer made resources that provide unique benefits over those developed by academic staff. We have evaluated through quantitative research the impact they have on learning and knowledge retention, compared to

that of traditional resources such as text, video and interactive video.

Having successfully built a national and International education brand called Soton Brain Hub on YouTube over a five year period we are now in a position to make a compelling case for extending the 'students as partners' model beyond the standard and typical examples of engagement. The co-creation approach towards the construction of online resources is an inclusive and innovative approach offering some clear and distinctive advantages.

The case for student partnership work has already been well documented by The Higher Education Academy but its adoption does involve a shift in our academic culture which has the potential to conflict with hierarchical structures within Higher Education institutions. Apart from establishing trust, the most important role of the faculty within the partnership becomes one of quality assurance and adherence to academic integrity policies.

This work has been carried out with approval from the Faculty of Medicine's ethics committee.

Development, aging and degeneration

S168

Effects of Aerobic Exercises on Synaptic plasticity and PDE-4 DNA gene methylation Level in Aging Rat Hippocampus

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The rats were moderate load and aerobic exercise intervention in pre-D-galactose-model and D-galactose modeling process to explore different influence periods of aerobic exercise in aging process. Adult male 3-month-old SPF SD rats, 60, 400 ± 20g. Control group (C), Aging model group (A), Exercising before the modeling group (E1), Exercising in the modeling group (E2). Except for C, the remaining rats were injected with D-galactose.E1 carried out swimming exercise before modeling, E2 did during it. Then, decapitated, stripped, Nissl staining, immunofluorescence, Real-time PCR, Western Blotting, DNA methylation and Analsis. (1) C good mental state, agile, eating normal, uniform and shiny hair, body robust; A was the opposite. Four weeks before the weight were steady growth (P> 0.05); Except for C, the others' growth slowed to varying from the fifth week; the changes in tenth weekend trends: C > E2 > E1 > A. (2) C, the hippocampal neurons neat, dendrites Nissl colored uniform; A was the opposite. (3) IOD values of Syp and mGluR1: A /E1 were significantly lower than C (P<0.01), E1 was significantly higher than A (P<0.05), E2 significantly higher than A / E1 (P<0.01).(4) Real-time PCR and Western Blotting were in the same trends: A was significant higher than C (P<0.01); E2 was significant lower than A /E1 (P<0.01). (5) 5 sites methylation levels vary, C/E2 have a relatively high level of methylation, A /E1 relative methylation levels lower. (6) Syp IOD / mGluR1 IOD and PDE-4 mRNA /protein expression showed a significant negative correlation (P<0.01);(2) Aerobic exercise can PDE-4 gene hypermethylation, enabling the gene inactivation by down-regulating the expression of mRNA and protein, reduce the inhibition of downstream gene pathway. (3) The different periods of aerobic exercise on brain aging intervention were different, intervention during in the aging process better.

The developmental anatomy of craniofacial and neural tube bitth defects and prosects for their repair and prevention

S170

Congenital disorders of neural tube development and progress towards primary prevention in a mouse model

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Neural tube defects (NTDs) arise during early pregnancy and are among the commonest congenital defects in humans, affecting 0.5-2 per 1000 established pregnancies. The majority of NTDs occur sporadically (i.e. without a strong family history) and are thought to result from the combined action of both genetic and non-genetic risk factors.

NTDs are traditionally considered to arise from failure of neurulation and, while this is true for 'open' NTDs (e.g. anencephaly, open spina bifida), NTDs such as encephalocele arise post-neurulation. Evidence from a mouse model will be presented to show that the same genetic defect can predispose to either open cranial neural tube (exencephaly) or post-neurulation brain protrusion (encephalocele) in different individual embryos.

A series of developmental events is required for the neural tube to close successfully. Embryonic shaping, for which planar cell polarity (PCP) function is essential, ensures that the neural tube initiates closure. If shaping is faulty, through defective 'convergent extension' cell movements, then the severe NTD craniorachischisis results. Subsequently, the neural folds bend and elevate to enable fusion in the dorsal midline. The range of gene products, molecular interactions and cellular events that are required for these morphogenetic transitions will be summarised.

NTD prevalence is lowered by folic acid (FA) supplementation in early pregnancy, although a proportion of NTDs occur despite FA usage. Inositol prevents NTDs in the FA-non-responsive Grhl3 mouse, and we extended this work to humans in the PONTI (Prevention Of Neural Tube defects by Inositol) pilot clinical trial. UK women with a previous affected pregnancy had no NTD recurrences after taking inositol + FA, whereas several recurrences occurred among pregnancies supplemented with FA alone. A large-scale clinical trial of inositol is required to determine whether combined inositol + FA supplementation should be recommended for all women planning a pregnancy.

Cranioskeletal birth defects and their possible prevention

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Craniofacial anomalies account for approximately one-third of all birth defects, and common anomalies such as cleft palate, craniosynostosis, and mandibulofacial dysostosis can occur in isolation or as part of one of nearly 700 distinct syndromes. Most of the bone, cartilage and connective tissue of the head and face is derived from a stem cell and progenitor cell population called neural crest cells. Congenital craniofacial anomalies are therefore typically associated with defects in neural crest cell development. Understanding the etiology and pathogenesis of craniofacial birth defects is dependent upon knowledge of the mechanisms that govern neural crest cell formation, migration, survival and differentiation. Recently, we discovered that ribosome biogenesis, the process of making ribosomes which are essential for protein translation in all cells, plays an essential role in neural crest cell proliferation and survival during craniofacial development. Ribosome biogenesis commences with transcription of rDNA by RNA Polymerases I and III, and this event is considered a rate-limiting step in ribosome biogenesis. Mutations in genes that encode subunits of RNA Polymerase I, or its associated factors, lead to deficiencies in ribosome biogenesis, neural crest cell apoptosis, and consequently congenital craniofacial disorders such as Treacher Collins syndrome, and Acrofacial Dysostosis - Cincinnati type. Inhibition of neural crest cell death is capable of ameliorating and in some case completely preventing craniofacial malformations in mouse and zebrafish models of these syndromes. Through investigating fundamental mechanisms that regulate neural crest cell biology, our work is facilitating the development of therapeutic approaches to prevent the pathogenesis of congenital craniofacial birth defects.

S172

Craniosynostosis and the neural crest lineage: contributions of cilia to skull development in mouse

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Craniosynostosis or the premature fusion of the cranial sutures affects approximately 1 in 2,500 live births. Anatomically, the craniofacial skeleton is formed from embryonic neural crest and mesoderm; both lineages contribute mesenchymal precursors during formation of the skull bones. The majority of cranial sutures also include a proportion of neural crest-derived mesenchyme, suggesting that the juxtaposition of these different anatomical lineages is important for establishment of the mature bones. In this work, we use mouse models to highlight the differing osteogenic capabilities of neural crest versus mesodermal mesenchyme. We also illustrate a requirement for cilia and cilia-dependent signaling in the neural crest during skull development. Finally, we identify a novel missense variant in the ciliopathy gene FUZ, which causes craniosynostosis. Using animal models, we assess FUZ requirements at key steps during skull development: from neural crest induction and migration, to establishment of skeletal condensations, and subsequently during ossification. Altogether, our studies demonstrate the importance of understanding the embryonic and developmental anatomy of the head when considering birth defects affecting the skull.

European perspectives on the use of cadavers in anatomy teaching and assessment: challenges and solutions

S174

The dissecting room: different reactions to prospective practices of students in several Health Sciences degrees.

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Practices in the dissection room are common in Health Sciences degrees all over the world, also in Spanish Universities. They provide to Anatomy students an opportunity to assimilate concepts acquired in theory classes. The aim of this work is to evaluate the reactions of Podiatry, Nursing, Physiotherapy and Medicine students against a prospective practice with cadavers and anatomical items.

This is an observational and descriptive study conducted on more than 200 students. All participants were of legal age and signed an informed consent form to take part. After the first practice in the dissecting room, a questionnaire of 29 simple dichotomous alternative response questions (yes/no) was completed. The questionnaire was structured in three sections to determine: physical reactions, distress and coping methods used by the students.

The most frequent physical reactions in the dissection room were: disgust, uneasiness, and nausea. Regarding the distress, they highlighted: the smell of the cadavers, the smell of the dissection room and the sight of the cadavers. The most frequent coping methods used were: being with friends, eating before practicing, and practicing beforehand with anatomical atlases and CDs.

Practicing in the dissecting room has an impact on Health Sciences students, whether they are studying medicine or another health degree. Students identified social support as a key coping method. So, it is very important the social and teaching staff support, to favor their adaptation, as well as previous practicing with tools such as models and anatomical atlases.

S175

Combined impact of simultaneous 3D digital visualisation and 3D printed model usage on anatomical understanding

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We have identified that students find learning of certain anatomical topics and concepts to be troublesome. Understanding 3D spatial relationships and identifying structures in clinical images are particularly demanding activities. Digital visualisation approaches are rapidly and widely being introduced into anatomy education. Such resources include interactive visualisation tables and 3D printed (3DP) models. We aim to utilise these technologies to support student understanding of challenging anatomical concepts.
We developed a small-group anatomy learning activity as part of a wider cadaveric cardiovascular anatomy practical, combining the use of CT scans and 3D images on a Sectra visualisation table with the simultaneous use of 3DP heart models. We employed a mixed-method experimental and survey approach to compare our Sectra+3DP activity to the use of cross-sectional 2D images.
Medical students at Newcastle University (n=330) completed pre-post testing to identify changes in their anatomical understanding and image interpretation ability. A questionnaire and focus group provided exploration of student perceptions. Data were analysed statistically and by semi-quantitative thematic analysis. The study was performed with ethical approval and with the understanding and consent of participants.
While improvements were highly significant ($p<0.001$) between pre and post testing for both activities, student performance was significantly higher ($p<0.001$) when using Sectra+3DP when compared to the 2D activity. We propose that simultaneous visualisation of interactive cross-sectional and 3D images and physical 3D models can enhance student understanding and appreciation of the structure, position and relationships of anatomical features above and beyond the use of 2D clinical images.
Our findings will have implications for how digital visualisation technologies are utilised in anatomy education and how anatomy and radiology are integrated within medical curricula.

S176

Full-text analysis of students' reflections as a method of evaluating the dissecting course

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When evaluating courses such as the anatomical dissection course, usually a questionnaire is used. These questionnaires vary from institution to institution and the results are therefore difficult to compare. In addition, students using questionnaires can only provide answers to predefined questions, so that their actual thoughts about the dissection course are not adequately mapped.
We had the students write a portfolio during the dissecting course. Part of this portfolio were two free-written, brief reflections on the dissection course, one at the middle of the course and one at the end. These reflections were extracted from the portfolios and analyzed by full-text analysis (Jigsaw Visual Analytics System).
347 mid- and end-course reflections were included in the analysis. We were able to identify and analyze five main domains: (1) students' overall assessment [26 items], (2) description of specific characteristics [88 items], (3) self-assessment of the student's personality [29 items], (4) the description of physical symptoms [62 items], and (5) statements about teamwork [82 items].
Students felt that the dissection course was a "very nice time" of "fundamental importance" (1), which was – nevertheless – "exhausting" and "intensive" (2), made them "satisfied", "more

secure" and "respectful", but sometimes "overwhelmed" (3), with a high level of "stress", "exam anxiety", and "exhaustion" (4), but also with a lot of "fun" and "motivating" "teamwork" and "friendships" (5).
The use of a full-text analysis of student reflections allows much deeper insight into the students' disposition on the dissection course than a pre-designed questionnaire would do. On the one hand, this tool can be repeated at any time and, on the other hand, based on the results of this analysis, a much more refined questionnaire for the student evaluation of the dissecting course could be created.
The students' reflections were part of their written portfolio, which they had to create as one component of activities to be assessed. Special approval by the Ethics Committee was not required.

S177

Unskilled and Unaware: Self-assessment of First and Second Year Medical Students in Anatomy Spotting Examinations

Isabel Stabile[1], Miguel Fenech[1]
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Introduction: The ability to accurately assess one's own strengths and weaknesses is fundamental to self-directed lifelong learning. The aim of the study to investigate the ability of low and high performing students in judging their performance in their practical anatomy exams.
Methods: At the end of the practical spotting exams Year 1 and 2 students were asked to estimate the mark they felt they had obtained. The difference between actual and perceived marks was further analysed based on gender, nationality and year of study.
Results: 189 Year 1 and 183 Year 2 students sat for the exams. A statistical significant difference of 9.9 and 12.4 marks was found between actual and perceived results for Years 1 and 2 respectively. High performing students estimated an average of 18.4 marks below their actual mark, compared to 2.5 marks for low performing students. A statistically significant difference of 13.1 marks was found for female compared to 5.6 marks for male students. There was no difference based on nationality or between Year 1 or 2 students.
Conclusion: Overall, students were unable to accurately judge their performance, although males and low performing students were better able to estimate their marks. It remains to be determined whether this lack of insight also extends to written examinations and whether poor performers overestimate their performance because their relative incompetence deprives them of the skills needed to recognise their deficits.

S178

Body Donation at the NOVA Medical School in Lisbon from 1982 to 2018: Providing sustainability for pre and post-graduate courses with cadaveric dissection

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Maintaining the regular practice of cadaveric dissection has always been one of the main concerns, since the foundation of the Anatomy Department of the NOVA Medical School in Lisbon, Portugal. This implies the commitment to develop and improve a well-organized Donation Office, a good cadaveric conservation technique and the regular training of dissection skills by our staff. The Department of Anatomy of the NOVA Medical School, in Lisbon, is well equipped to receive and preserve every donated body, to ensure the existence of cadavers for dissection in Pre-graduation and Post-graduation courses. Currently, two Pre-graduation Anatomy dissection courses and a yearly average of fourteen Post-graduation cadaveric courses, of numerous medical and surgical specialties, are held in the Department of Anatomy. Portugal has a well-defined legal framework for the use of

human cadavers for teaching and research, the Decree-Law 279/99, published in July of 1999, which clearly defines how every donation program in the country should be organized. The donating program organization and procedures followed in our institution strictly follow these legal precepts. Statistical data from the Donation Office show that, between 1982 and 2000, an average of four donations per year were received in the Department, which dramatically contrasts with the average of 162 donations per year received between 2001 and 2018, after the publication of the aforementioned decree-law. Of these donations, 72% were female donors and 28% were male.

S179

A Look at the Anatomy Educator Job Market: Anatomists Remain in Short Supply

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In 2002, a widely publicized report projected an anatomy educator shortage based on the perceptions of department chairpersons. Now, with the number of medical and health professions programs around the world higher than ever, does a perceived shortage of anatomy educators continue to persist? If there is a shortage, how severe is it and is it a global phenomenon?

This study replicated and expanded upon the previously published 2002 report. Two surveys were internationally distributed to 1) departmental leaders and 2) trainees (i.e., graduate students and postdoctoral fellows) within anatomy-related departments. Trends in the number and type of anatomy educator job openings were also explored by analyzing job postings within the US over the past 2 years. Descriptive statistics were used to evaluate perceptions, historic trends, and future projections.

The majority (51% or more) of departmental leaders who responded from the US/Canada (n=81), the European Union (n=52), and 'other countries' (n=26) anticipate they will have 'moderate' to 'great' difficulty hiring anatomy educators in each of the four classic anatomy disciplines over the next five years. Within the US alone, the number of AE job postings for allopathic and osteopathic medical schools has increased from a minimum of 21 postings in 2017 to 52 postings in 2018. While the number of open AE positions within the US/Canada and 'other countries' is perceived to remain in a steady state over the next 5 years, the European Union estimates a 5 fold increase in the number of openings. Departmental leaders prioritize AE applicants who have teaching experience (90%), the ability to teach multiple anatomy disciplines (72%), and the knowledge/experience of employing different teaching pedagogies (65%).

Based on the perceptions of international departmental leaders and trends in documented job postings, the job vacancy gap for AEs continues to widen.

The 'One-Health" paradigm: towards mapping the overlaspping domains between the veterinary and human anatomy for clinically relevant applications

S180

Functional anatomy of the equine auditory (Eustachian) tube

David Kilroy[1], Arun Kumar, Geraldine Shallow
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As with other mammals, the equine auditory (Eustachian) tube extends from the nasopharynx to the middle ear cavity. In the domestic horse and donkey, a large caudoventral bulge in the mucosa of the auditory tube forms the guttural pouch, an air-filled diverticulum (volume 400 ml per pouch). This feature occurs in some other Perissodactyla (tapirs) in addition to the hyrax. Along with the auditory tube and middle ear (tympanic cavity), each guttural pouch develops from the endoderm of the first pharyngeal pouch and is lined by pseudostratified ciliated columnar (respiratory) epithelium.

The right and the left guttural pouches meet each other medially to form a thin septum. The stylohyoid bone incompletely divides each guttural pouch into medial and lateral compartments. The pouches are in close contact ventrally with the pharynx and caudally with the atlantoaxial joint; the roof of the pouch touches the ventral floor of the braincase. Its principal clinical significance is the proximity of each pouch to the internal carotid artery, the wall of which can be damaged by fungal infection of the pouch, leading to profuse epistaxis.

Several functions have been suggested for the guttural pouch: cooling the arterial blood flowing to the brain during exercise is the currently favoured option. Others include buoyancy of the head, pressure regulation with inspiration or the production of vasoactive substances.

This talk will introduce some experimental results on the latter theory and will attempt to elucidate the function of this unusual structure.

S181

Comparative anatomy – occasional exemplars within an undergraduate medical curriculum

Jane Holland[1]
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Embryology has traditionally been considered a sub-discipline of anatomy, typically taught within the pre-clinical years, with specific conditions then revisited within clinical specialties as appropriate. With crowded curricula and increasing class sizes, this component of the undergraduate medical curriculum is primarily lecture-based in many institutions, with few retaining any small group teaching or laboratory components, which would allow for more active learning and engagement between staff and students. Furthermore, while clinical cases or exemplars may be introduced to contextualize the lecture content, and highlight (future) clinical relevance, a balance must be struck between using these cases to engage or arouse interest in embryological processes, and risking information overload with advanced clinical content. An alternative is to bring in occasional animal exemplars, to show how some structures that regress, or are replaced, in human embryology, still persist within other classes or orders of the animal kingdom. This presentation intends to frame a discussion, drawing on the experience of the presenter in this regard, and to engage the audience to volunteer or consider what exemplars may be of relevance in their own practice.

S182

How do domestic mammals use their shoulder joints?

Jonathan Holmes[1]
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Most domestic mammals are cursorially specialised. In all these species the clavicle is either vestigial or lost. Further adaptations for running include the flattening of the thoracic cavity from side to side and the swinging of the scapula in line with the rest of the forelimb bones. The junction between the trunk and the forelimb is a synsarcosis. The limb is free to move as a whole on the trunk in the sagittal plane. For efficient ground progression these animals need to flex and extend all the joints of the limb, including the shoulder, in the sagittal plane whilst restricting all other movements. The shoulder is structurally a ball and socket joint with potential

movement in three planes. The gleno-humeral joint in all these species is very shallow, yet dislocation of the shoulder is rare. In practice, the shoulder, certainly during ground progression, only flexes and extends. Gleno-humeral, essentially collateral, ligaments have developed both laterally and medially but they are very weak. The Infraspinatus muscle laterally and the Subscapularis muscle medially have very short tendons of insertion close to the joint and so act essentially as giant ligaments, holding the whole joint in the sagittal plane. In addition the tendon of origin of the Biceps brachii muscle runs very close to the cranial aspect of the shoulder, further stabilising the joint cranially. Abduction and adduction of the shoulder are rarely seen (only in unusual circumstances such as the splaying of the legs of giraffes in order to drink). The Deltoid muscles lie caudo-lateral to the joint and are well-placed to act as abductors but in practice assist in flexing the shoulder joint. Some muscles of the Trunco-Brachial Junction are well-placed to aid the intrinsic flexors and extensor of the shoulder during running.

S183

Reproductive tract cancers – What can we learn from the veterinary anatomy?

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Comparative oncology provides with a wealth of information which are vital in understanding the pathophysiology of various cancers. Unfortunately, an in-depth study of the comparative reproductive tract cancers is rare. An existing challenge is the lack of extensive epidemiological data in veterinary science. Still, the overall incidence of reproductive tract cancers for both the genders are comparatively lesser in animals including common pets e.g., dogs and cats, than humans. One explanation can be the neutering of the animals done often in the US or Europe. However, even within the non-neutered animals, the incidence of such cancers, both in females (e.g., ovarian cancer in the bitches) and males (e.g., testicular cancers, such as the seminoma, Sertoli cell or interstitial cell tumors in dogs), are comparatively lesser. An obvious correlation can be made based on the fact that animals, especially the wild ones, are much less exposed to the carcinogens - natural or induced (e.g., smoking, organic solvents) - than the humans. Another intriguing topic is the "Peto's paradox", eponymized after Sir Richard Peto (University of Oxford), which explains that many bigger animals, such as, the elephants or the blue whales, rarely demonstrate cancers despite having many more cells and comparable lifespan to the humans. For example, only <5% of the elephants suffer from cancer despite having 20 folds higher cells in the body than the humans; and an average lifespan of 70 years. This was further explained by the fact that bigger animals, such as the elephants, carry multiple copies (e.g., twenty in the elephants) of the tumor suppressor p53 gene compared to the single copy found in the humans. This talk will investigate such realms of comparative oncology while distil out few interesting patterns which hopefully will guide further research and better comprehension of a highly complex disease like cancer.

S184

Comparative ocular gene therapy: How curing inherited blindness in Briard dogs benefits everyone.

Alison Reynolds[1]
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Laboratory animals (zebrafish, rodents, rabbits, dogs and primates) have been used for decades to model various forms of ocular disease and in the discovery and development of therapeutics.
Leber congenital amaurosis (LCA, OMIM # 20400) is a family of rare, inherited, early-onset severe retinal degenerations (EOSRDs) which affects 1 in 80,000 and presents in infancy. This disorder results in severe blindness at or near birth. LCA is a genetically and mutationally heterogeneous disease and can result from dominant or recessively inherited mutations in 1 of 26 genes, including retinal pigment epithelium 65 (RPE65).

Briard dogs are a spontaneously occurring model of LCA, with mutations in the Rpe65 gene causing a canine version of the human disease. Due to the similarity of LCA in Briard dogs and in humans, the canine model was used to develop an ocular gene therapy product for the human market.

Here we will briefly discuss the validity of vertebrates and mammals as model organisms for ocular disease. We will examine how treatment of LCA in Briard dogs has successfully led to the first FDA-approved gene therapy product (Luxturna; voretigene neparvovec).

Quantifying muscle anatomy and function in health and disease: what do we know, what are we doing and where are we going?

S186

Clinical anatomy research is still relevant!

Helen Nicholson[1]

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While the general public often consider anatomy as a dead subject, advances in medical technology mean that a detailed understanding of the complexity of the human body is vitally important. Over recent years there has also been an increase in technologies that have been developed and refined for the field of clinical anatomy. It is important to be aware of, and understand the intricacies of the range of "tools" now available in the anatomist's "toolkit". In addition, it is equally important to appraise the factors that the more traditional approaches still have to offer, particularly in light of recent recommendations to enhance evidence-based anatomy through standardised reporting of anatomical studies. This talk will highlight recent developments in evidence-based clinical anatomy research and provide an introduction to available resources (e.g the Anatomical Quality Assurance [AQUA] checklist) that are readily available and can be easily implemented to facilitate research in this field. This will set the scene for the remaining presentations, which using the hip abductor muscles as an example, will outline various complementary methods for examining muscle morphology and function.

S187

The evidence-base for the segmental arrangement of muscles

Natasha Flack[1], Quentin Fogg[2]

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An understanding of muscle architecture is fundamental to understanding its function. This requires the definition and measurement of architectural parameters, such as attachments, fascicle angle, physiological cross-sectional area (PCSA) and innervation patterns, which may be achieved through radiologic analysis or cadaveric dissection. Clinical imaging modalities such as magnetic resonance (MR) imaging, computed tomography (CT) and ultrasound (US) permit analysis of the living anatomy and can incorporate a varied age range, allowing investigations into understanding how anatomy, or age-related changes, can develop. However, resolution issues, short scanning times (radiation exposure and/or practicality), and financial barriers limit the usability of these data. Moreover, even with optimised scanning conditions, interpretation and identification of different tissues can remain a challenge. Direct observation of cadaveric tissue is ideal for structure identification. Through fascicular dissection, attachment sites can be isolated, fascicle angles and PCSA can be measured, and primary and secondary nerve branch entry into the muscle belly can be accurately traced and mapped. Unfortunately, dissection is often restricted by specimen age and is ultimately destructive. Combining dissection with 3D microscribe digitisation negates the latter limitation and, when supported with CT/MR/US

imaging, ensures that a complete understanding of the anatomy can be obtained. Together these parameters are central to determining whether a muscle laminates into macroscopic, tissue-specific and functionally distinct units. With a clear architectural and spatial understanding of a given muscle, data can then be used to inform functional studies (e.g. electromyography), tissue-type investigations (e.g. immunohistochemistry to determine fibre types and distribution) and can aid the understanding of musculoskeletal conditions. This talk will use the gluteal muscles as an example to outline these aforementioned approaches to investigating such anatomical parameters, highlighting how these methods should be used to complement one another and will provide an excellent template for investigations of other muscles and fascicular tissues.

S188

What do we know about tendon vascularity and innervation?

Alexandra Webb[1], Stephanie Woodley[2]
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Tendons are more vascular than commonly accepted. This vasculature is important in tendon damage and repair, and knowledge of the anatomy of tendon vascularity is essential to understanding tendon pathology in musculoskeletal disease. Micro-computed tomography (CT) angiography offers the potential to visualise, quantify and establish the spatial relationships of the microvasculature of muscles and tendons not readily visible using CT angiography. Unlike histology, micro-CT can be performed without tissue destruction to facilitate three-dimensional visualisation, quantification and spatial relationships of the tendon and muscle blood supply. Similarly, histology and immunochemistry can be used to facilitate quantification of the size, density and location of neurovascular structures within tendon. Despite the technological advances in CT and ultrasonography, histology and immunohistochemistry provide the most robust methods for determining the vascularity and innervation of tendons. Given the importance of vascular supply for tendon healing, the presence of an area of tendon hypovascularity could have implications for enhanced understanding of gluteal tendinopathy. However, the microvascularisation of the hip abductor tendons is not well understood and the presence of a critical zone of hypovascularity is not clear from current studies. Likewise, information pertaining to the detailed innervation patterns of the gluteal tendons is lacking. Further research is required to elucidate the patterns of gluteal tendon neurovascular supply to better understand the potential implications of this anatomical parameter in hip-related conditions.

S189

Using imaging to assess pathoanatomy associated with dysfunction

Stephanie Woodley[1], Alexandra Webb[2]
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The quantitative assessment of muscle morphology (e.g. size and adipose tissue infiltration) using ultrasound and magnetic resonance (MR) imaging is important for understanding musculoskeletal conditions. They are powerful techniques that can be used to identify and evaluate disease, or used as a biomarker to assess disease progression or therapeutic response. The application of these techniques relies on: (i) a comprehensive knowledge of anatomy to ensure the accurate identification and segmentation of muscles on MR images; (ii) knowledge of appropriate MR sequences to facilitate the accurate quantification of muscle morphology parameters; and (iii) an awareness of the limitations of each technique and the factors that may affect their accuracy, which is important for interpreting muscle morphological parameters in a clinical context. Ultrasound shows promise as a reliable modality

for assessing hip abductor muscle volume and thickness, although the depth and quality of gluteus minimus tissue in older people presents some limitations to this technique. Based on volume MR measures, gluteal muscle atrophy has been linked to hip conditions such as osteoarthritis and greater trochanteric pain syndrome, and is also evident with normal ageing. A reduction in muscle size may be accompanied by increased fatty infiltration (particularly gluteus minimus and gluteus maximus); however, these findings have been based upon a five-grade qualitative classification system of MR images rather than quantitative measures. Quantification of intramuscular fatty infiltration using T1-weighted or Dixon MR imaging overcomes the limited reliability and sensitivity associated with the current five-grade classification system. In future work, principal component analysis has the potential to establish the key features of shape that represent disease and therapeutic changes affecting skeletal muscles.

S190

EMG assessment of muscle function in health and disease

Rod Green[1]
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Electromyography (EMG) provides a mechanism for verifying assumptions of muscle function as inferred from cadaveric studies and MR imaging. For deep muscles like gluteus medius (GMed) and minimus (GMin), an intramuscular EMG protocol utilising fine wire electrodes placed into the muscle using sterile procedures allows for the collection of data from specific muscle segments. Doppler ultrasound guidance was used to avoid injury to neurovascular bundles. The protocols for electrode insertion are informed by a detailed understanding of muscle morphology, particularly in relation to fibre orientation and innervation patterns. Protocols developed allow insertion into functionally unique segments of GMed (anterior, middle & posterior) and GMin (anterior and posterior). Studies in healthy young adults are used to establish typical muscle activity patterns during everyday functional tasks such as gait and stepping tasks. Data from our laboratory has shown that the muscle segments are functionally unique during a range of activities, although all of the five muscle segments show variations of a biphasic pattern during the stance phase of the gait cycle. This allows for the interpretation of any altered muscle activity patterns in pathological populations. Recent studies in hip osteoarthritis patients have shown a deviation from the normal patterns of gait, particularly a reduction in anterior GMin activity in the late stance phase, that are likely to be linked to a shorter stride length. Interestingly, the patterns also appear to be different in asymptomatic older participants when compared to healthy young adults, indicating that there may be age-related changes in the muscle activity patterns as well. Altered gluteal muscle activity patterns have also been shown in patients with greater trochanteric pain. The identification of differences in muscle activity can be used to then target particular muscle segments in rehabilitation programs to try and restore normal function.

S191

Implications of anatomical evidence for clinical rehabilitation

Stephanie Woodley[1], Rodney Green[2]
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A detailed understanding of the anatomy of muscle, including potential deficits in its morphology and function, is valuable to informing the clinical management of patients with musculoskeletal conditions. As an example, current evidence demonstrates several gluteal-related impairments that are common to hip osteoarthritis and gluteal tendinopathy, and which may or may not be related to clinical severity. These impairments include muscle atrophy (particularly gluteus minimus [GMin]), increased muscle adiposity (particularly anterior GMin, with increasing age and pathology; posterior GMin with pathology), and reduced hip abductor strength. Altered patterns of muscle activity as shown with electromyography, such as

a reduced contribution of anterior GMin towards the end of stance phase of gait and changes in the activity of gluteus medius during more demanding tasks (e.g. a 'step-up'), have also been described. People with hip pathology may also present with other gait-related impairments including reduced speed and cadence, and asymmetry. Based on this anatomical and functional evidence, we have designed and are currently trialling a progressive, structured 12-week physiotherapy-supervised rehabilitation programme for people with hip osteoarthritis. This pragmatic program integrates: (i) motor control strategies to promote the function of specific muscle segments that are prone to atrophy, particularly anterior GMin; (ii) gait retraining to normalise, prevent or minimise gait-related impairments; and (iii) high intensity exercise to improve pelvic stability (targeting gluteus medius and GMin) and overall lower limb and trunk strength and function. Specific examples of included exercises, which require minimal equipment, will be discussed. This rehabilitation programme highlights how evidence-based anatomical and functional research findings can inform and be translated into clinical practice, with the aim of improving function and increasing activity levels in people with hip dysfunction.

S192

Anatomy Nights: an engagement platform bringing experts to the public

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Anatomy Nights is a public engagement event created, organised, and hosted by anatomists that highlight the amazing architecture of our bodies. The public's appetite for anatomy is growing. However, the involvement of experienced and expert anatomists in many popular events is limited and it is time we got involved. In 2018 and 2019, we held three sold-out Anatomy Nights across 9 locations around the world, reaching an audience of over 1000 people.

Anatomy Nights brings the fundamental practice of dissection (non-human) into the public sphere and gives audiences a chance to hear from anatomy experts in casual spaces such as bars and pubs. The aim of the event is to increase the publics' knowledge about their own bodies. As the audience enters they complete a pre-talk questionnaire that establishes baseline knowledge. The data from these questionnaires provide insight into the standard level of public anatomy knowledge and common misconceptions. After the dissection, the questionnaire is repeated. Everything in the questionnaire is covered in the talk, so we can see from the responses what particular anatomical knowledge the audience now know, and what topics people still struggle with.

Past events have been hosted by both seasoned and novice science communicators. A key benefit of the shared platform is that we are building a public engagement community in anatomy with a common goal: to ensure that the public has greater access to anatomy knowledge from reliable and expert sources; the anatomists themselves. We aim to encourage more anatomists to step out of the lab and host their own Anatomy Nights events around the globe, with the support of a growing Anatomy Nights community that brings the anatomist directly to the public.

Oral Communications

O001

mTOR inhibition enhances the neuroprotective effects of C-terminal Mechano Growth Factor peptide on adult rat facial motoneurones

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The protease-resistant C-terminal 24 amino acid sequence of an isoform of Insulin-like growth factor-1 (IGF-1) isolated from active muscle (MGF24) is neuroprotective, but its mechanism of action is poorly understood. To determine whether MGF24, like IGF-1 generally, acts through mammalian target of rapamycin (mTOR), we have compared motoneuronal protection by MGF24 when mTOR was inhibited by the drug Rapamycin.

The right facial nerve of groups of 6 adult anaesthetised Sprague-Dawley rats was avulsed at the stylomastoid foramen and 10µl of either (i) Rapamycin (100 µg/µl); (ii) MGF24 (1 µg/µl); or (iii) Rapamycin plus MGF was injected into the foramen. Control groups comprised non-operated rats, avulsion alone and avulsion plus saline vehicle. After 1-month, anaesthetised rats were perfusion-fixed and total numbers of facial motoneurones determined using an optical disector method modified for use in the confocal microscope

Nerve avulsion alone and avulsion plus saline resulted in 20-30% motoneuronal survival at 1 month ($P<0.05$). MGF24 alone or Rapamycin alone resulted in 50-55% motoneuronal survival ($p<0.01$), and Rapamycin plus MGF24 resulted in 87% motoneuronal survival ($p<0.01$).

Our results indicate that the protection of rat injured facial motoneurones by MGF24 does not involve mTOR and that Rapamycin enhances MGF24 neuroprotection. While there have been several reports of Rapamycin promoting neuronal survival in other experimental models, by contrast it promotes motoneuronal loss in the SOD-1 (G943A) mouse model of Motor Neurone Disease. This suggests that variables, such as system, species and experimental model affect Rapamycin action.

This study was approved by The University of Adelaide Ethics Committee (M-2013-057C).

O004

Mapping the developing and adult human brainstem: genetic neuroanatomy

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Traditional mapping of the human brainstem, as of other anatomical structures, is based on information from Nissl and myelin-stained sections, and information from connections and physiology. Using chemical markers for marking started with acetyl cholinesterase staining from 1982 onwards, continuing with tyrosine hydroxylase staining for monoamines, and antibody markers (i.e. calbindin, parvalbumin). Following recent developments in molecular biology and biotechnology, using gene expression for defining anatomical structures is a new concept. With in situ hybridization (ISH), it is possible to localize DNA and RNA within intact cells and tissues without destroying the structure. Anatomical organization of the human brainstem is a complex mixture of compact neuronal groups (nuclei) and dispersed cell areas with varying cytoarchitecture. There are 438 structures we have defined so far in the human brainstem (Paxinos et al., 2012).

In this study, analysis of the human brainstem from the Allen Institute BRAINSPAN Atlas of the Developing Human Brain and Atlas of the Human Brain projects were made, and based on the reference atlases for these projects (reference atlas for the developing 21 post-conception weeks (pcw) human brainstem was prepared by Sengul), gene expressions were analyzed which could be useful for mapping the developing and adult human brainstem. As examples, calretinin gene CALB2 was expressed in the solitary nucleus,

dorsal paramedian nucleus, and cochlear nucleus, glutamate gene GRIK2 in the gracile and cuneate nuclei, neuropeptide Y gene NPY in the intermediate reticular nucleus, and somatostatingene SST in locus coeruleus and medial parabrachial nucleus. This study shows how expression of genes in the brainstem define anatomy of the numerous nuclei, and prsent the digital reference atlases created for 15 and 21 pcw and adult human brain.(www.alleninstitute.org). No ethical approval was required for this study.

O005

Nerve identity crisis? Catecholaminergic neurons are embedded extensively throughout the peripheral neural substrate.

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The commonly accepted view at the peripheral autonomic division of the nervous system is that it consists of two efferent portions, the sympathetic and parasympathetic. An extensive literature search revealed that, except for CN XI, every cranial nerve and many spinal nerves contain (immune-)histochemically proven catecholaminergic fibers, and do contact sympathetic structures. Furthermore, catecholaminergic neural cell bodies are located in the periphery of the body, within peripheral nerves, within perivascular nerve plexuses and within all autonomic ganglia of the head, all of which are classically considered parasympathetic features. These findings do not comply with the classic description of the autonomic outflow that has been used up until today to assign neurons to the sympathetic - parasympathetic divisions. To address this issue, I will present a classification method that acknowledges the existence of a 'united peripheral neural substrate', in which neurons are embedded. This united, mesh-like, peripheral substrate contains multiple communicating branches that allow neurons to create pathways to connect different structures, comparable to the connectome in the brain. As such, questions of recent interest as to whether the vagus nerve innervates the spleen must be rephrased to which neurons innervate the spleen via what nerves. We published earlier that the human spleen receives no cholinergic innervation, but the possibility remains that the catecholaminergic innervation is partly conveyed by the vagus nerves. I will demonstrate that the cervical vagus and the entire phrenic nerves serve as morphological conduits for catecholaminergic fibers in man. Our findings imply that the sympathetic – parasympathetic model is no longer tenable in the 21st century. Therefore, I will also present an approach to teach the efferent autonomic innervation in a comprehensible way.

O006

Can the Cingulum get you down? A comparative study of cingula changes and their involvement in Depression

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Often called the superhighway of the brain, the cingulate gyrus is a key component of the limbic system and a pathway salient in communication within the cerebrum. This tract is a nexus for communication between the frontal, parietal and temporal cortices acting as a connecting network linking the subcortical nuclei to the cingulate gyrus. This enigmatic bundle is marked by its principal functions, which revolve around core processes incorporating executive function, decision making and emotional processing . These functions suggest the involvement of this tract in

Major Depressive Disorder (MDD), a condition for which underlying neurobiological mechanisms remain elusive.

This investigation aimed to put this bundle under a spotlight using advanced neuroimaging techniques to study involvement in MDD pathophysiology. 50 healthy controls and 50 depressed participants were scanned using high-resolution T1, T2 (1mm isotropic) MR imaging and High Angular Resolution Diffusion Imaging (HARDI) at the Trinity College Institute of Neuroscience (Phillips, Intega 3T). Whole brain tracts were calculated from diffusion weighted scans using Constrained Spherical Deconvolution (CSD) and a boolean logic based protocol was implemented to virtually dissect the cingula.

Macroscopic and microscopic data from these virtually dissected cingula analogues was extrapolated and statistically examined. Overall changes with age were observed across the cingulum. A result consistent with previous studies. A diffusion metric often associated with tract integrity and a marker for myelination is Fractional Anisotropy (FA). Reduced FA was detected at the subgenual region in MDD and significant diffusivity changes were observed in the parahippocampal region.

In summary, this study confirms previous findings highlighting age-related changes in the cingulum while exhibiting it as a culprit in MDD pathophysiology.

O007

Motor-coordinating effects of Nigella Sativa oil on male mice models of sub-acute Parkinsonism

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This study was aimed at investigating possible candidates for the therapy of Parkinsonic defects in motor balance and coordination. Parkinsonism was thus induced sub-acutely using MPTP, while Nigella sativa was tested for its neuro-protective potential against some of the symptoms.
Forty young adult mice weighing between 20-25kg were used for the study. They were divided into four groups namely NS group (administered with 1mg/kg of Nigella sativa for 7 days, NSMP group (administered with Nigella sativa for 7 days and 18mg/kg of MPTP for another 5 days), Control group (administered with only normal saline for 7 days), and MP group (administered with 18mg/kg of MPTP for 7 days). Balance beam walk test was conducted on the mice, and the cerebellum harvested following cervical dislocation were processed for neurochemical and histological analyses.
Nigella sativa was shown neurobehaviourally to protect the Parkinsonic mice against motor imbalance or disharmony, by reducing the traversing interval for NSMP (but not the turning time). The NS group further behaved best by spending the least turning and traversing time. There were however no significant changes in the neurotransmitter and histological results using H&E stain. Nigella sativa was thus shown by this study to be a potential candidate in the treatment of motor symptoms of Parkinsonism.
The research was conducted in conformance with the ACUREC ethical guidelines of the Olabisi Onabanjo University.

O008

Analysis of the Distribution of Adrenergic Receptors in the Cerebral Vasculature: Implications for Alzheimer's Disease

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Accumulation of Aβ in the brain and in vessel walls as cerebral amyloid angiopathy (CAA), is a

key feature of Alzheimer's disease. CAA occurs as a result of the failure of drainage of Aβ from the brain along the basement membranes of cerebral capillaries and arteries as intramural periarterial drainage (IPAD). Vascular smooth muscle cells provide the driving force for the elimination of Aβ along IPAD. Experimental work targeting the adrenergic receptors of the vascular smooth muscle cells reduces CAA but the profile of receptors in the human cerebral vasculature is unclear.

To demonstrate the distribution of α-adrenergic receptors in young human cerebral blood vessels and show how this may change with ageing and CAA.

Sections of occipital lobe, taken at post-mortem from severely CAA-affected cases, as well as young and old controls, were stained for the α1A-adrenergic receptor using immunohistochemistry. Differences between the conditions were visualised by light microscopy and quantified in ImageJ using percentage area stained as comparison measurement. Statistical analysis was performed using 2-way ANOVA, with significance set at $p<0.05$. The localisation of the receptors in the vessel wall was revealed using immunofluorescence and confocal microscopy.

Significant decreases in overall α1A-adrenergic receptor expression in grey and white matter were observed in old and CAA-affected cases compared to the young. No significant differences were observed between young, old and CAA, specifically within the blood vessels of the grey and white matter. A significant increase in α1A-adrenergic receptor expression was observed in the leptomeningeal vessels of old cases compared to young controls and CAA. The pattern of staining within blood vessels changes with ageing and CAA to a less punctate, more diffuse pattern.

Preservation of α1A-adrenergic receptors in the cerebral vessels with ageing and CAA hold potential for therapeutic targeting to facilitate IPAD.

O009

Immune cells at the interfaces of the brain parenchyma with blood and CSF

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The brain contains several types of immune cells located in specific anatomic compartments. Macrophages surround the brain vessels and are found in leptomeningeal spaces and the choroid plexus together with other immune cells. From these privileged locations immune cells can sense the brain environment, interact with the vasculature, and play immunological surveillance and scavenging functions. However, the features and role of these cells is not fully understood. We studied immune cells in the brain following ischemic stroke in rodents and in post-mortem human brain tissue under the approval of respective ethical committees. Stroke induces a strong sterile inflammatory reaction involving the activation of glial cells and attraction of peripheral leukocytes to the injured brain tissue. Different types of immune cells reach the brain following an orchestrated pattern with peaks of neutrophils within the first 3- days post-stroke, followed by macrophages and other mononuclear cells, and lymphocytes, notably T cells that show peaks at longer time points (15 days). After stroke, neutrophils are seen in the leptomeninges and perivascular spaces within the infarcted tissue, where they accumulate for some time. From these locations, neutrophils eventually reach the brain parenchyma under conditions of severe brain damage affecting not only neuronal but also glial viability. We investigated whether brain resident perivascular macrophages (PVM) could be involved in attracting peripheral immune cells to the perivascular spaces after stroke in a rat model of transient middle cerebral artery occlusion. PVM cell sorting and transcriptomic analyses of differential gene expression under control and ischemic conditions showed upregulation of hypoxia responsive genes and increased expression of vascular endothelial growth factor (VEGF) and leukocyte

chemoattractants. Depleting the population of PVM reduced VEGF production, infiltration of neutrophils, and blood-brain barrier leakage after acute stroke. Our results suggest that PVM regulate immune cell infiltration and affect cerebrovascular function after stroke.

O010

Intramural Periarterial Drainage Pathways and the pathogenesis of neurological diseases

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Accumulation of the β-amyloid (Aβ) protein in cerebral blood vessels is a hallmark of Alzheimer's disease. Soluble Aβ from the extracellular spaces of the brain is removed along the basement membranes of capillaries and basement membranes surrounding smooth muscle cells of arteries towards the surface of the brain, as intramural periarterial drainage (IPAD). This process depends on the biochemical integrity of the extracellular matrix and the strength of arterial smooth muscle cells. With ageing, possession of Apolipoprotein E4 (APOE4) genotype, hyperlipidemia, maternal high fat, immune complexes, IPAD fails, resulting in the accumulation of proteins in the walls of cerebral arteries as cerebral amyloid angiopathy. Within 5 minutes of intracisternal injection, convective influx/glymphatic entry of Aβ from the cerebrospinal fluid into the cerebral parenchyma is along the glial-pial basement membranes and enters IPAD by 30 minutes. Clusterin (Apolipoprotein J) appears to be a chaperone for Aβ, facilitating IPAD and efficient innervation of cerebral arteries is key to maintaining optimal IPAD.

O011

Calcification Scarcely Occurs in Human Atrioventricular Nodal Arteries in Old Age

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To elucidate age-related changes of the atrioventricular nodal artery (AVNA), the authors investigated age-related changes of elements in the AVNA by direct chemical analysis. In addition, the effects of different arterial origins, arterial sizes, and genders on element accumulation were investigated in the AVNAs. Sixty-two formalin-fixed adult Thai hearts were dissected, and the following two types of the AVNA were found: (1) a single AVNA arising from the right coronary artery (RCA); (2) a single AVNA arising from the terminal part of the left circumflex artery (LCX). For element analysis, both 55 and 7 AVNAs arising from the RCA and the LCX, respectively, were used. After the arteries were incinerated with nitric acid and perchloric acid, element contents were determined by ICP-AES. It was found that the Zn content decreased significantly in the AVNAs with aging, but six element contents such as Ca, P, S, Mg, Fe, and Na did not change significantly with aging. Regarding the relationships among seven elements in the AVNAs, extremely significant direct correlations were found both between Ca and Mg contents and between P and S contents, and a significant direct correlation was found between S and Mg contents. However, no significant correlation was found between Ca and P contents in the AVNAs. To elucidate whether calcification occurred in the AVNAs in old age, both the mass ratios of Ca/P and Mg/Ca were estimated in the AVNAs. The mass ratio of Ca/P increased progressively in the AVNAs with Ca increase, being not constant. The mass ratio of Mg/Ca decreased gradually in the AVNAs with Ca increase, but the average mass ratio of Mg/Ca was moderate, being 8.9±0.9%. These results indicated that calcification scarcely occurred in the AVNAs in old age. The present study was approved by ethical committee.

O014

The Role of Efferent Transmitters in mouse Taste Bud Signal Transduction

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Previously, capsaicin-mediated modulation of taste sensations was thought to be produced indirectly by calcitonin gene-related peptide (CGRP) and substance P (SP) onto taste cells. The underlying assumption has been that neuropeptides exert their effects on taste transmitter secretion in taste buds of mice, as theoretically may relate to the processing of the gustatory information. We reported that CGRP elicited Type III cells to secrete serotonin (5-HT), which reduced ATP secretion from Type II cells during the gustatory stimulation. Furthermore, to test this assumption, using a combination of Ca2+ imaging with cellular biosensors – genetically-engineered Chinese Hamster Ovary (CHO) cells, transgenic mice expressing green fluorescent protein (GFP) in the specific taste cell type and immunostaining, we investigated the net effect of SP reduced taste-evoked ATP secretion from mouse taste buds. Specifically, SP elicited phospholipase C (PLC) activation-dependent intracellular Ca2+ transients in taste cells via neurokinin 1 (NK1) receptors, most likely on glutamate-aspartate transporter (GLAST)-expressing Type I cells. Recently, γ-aminobutyric acid (GABA) as well as the associated synthetic enzyme have been identified in Type I cells. Conceivably, Type I cells secrete GABA in respond to SP. Combined with the recent findings that GABA provides negative paracrine feedback onto Type II cells by activating GABAA and/or GABAB receptors and reducing taste-evoked ATP secretion, our results showed that taste-evoked ATP secretion from intact taste buds, which remain cell-cell communication intact, was reduced when SP was co-applied with taste stimuli in the bath medium. We conclude that SP plays a role as an inhibitory transmitter that shapes peripheral taste signals via GABAergic signaling during processing gustatory information in taste buds. This seemingly tangled complex represents a new concept of taste signaling and that neuropeptides released from afferent sensory terminals play a regulatory role in processing taste signals. Supported by AAA FGAP (AAA-3419), NIH and SIUSOM Research Grants to AYH.
Mice were killed following the National Institutes of Health guidelines, as approved by the Southern Illinois University School of Medicine Animal Care and Use Committee. All experiments were conducted following the guidelines of these two regulatory bodies.

O015

Overcoming Chemoresistance against Doxorubicin via Combined Inhibition of Tiam1/Rac1 and Notch in a Biomimetic 3D Lymphoma Model

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Lymphoma is a heterogeneous disease with a highly variable clinical course and prognosis. Improving the prognosis for patients with relapsed and treatment-resistant lymphoma remains challenging. Current in vitro drug testing models based on 2D cell culture lack natural tissue-like structural organization and result in disappointing clinical outcomes. The development of efficient drug testing models using 3D cell culture that more accurately reflects in vivo behaviors is vital. Our aim was to establish an in vitro 3D lymphoma model that can imitate the in vivo 3D lymphoma microenvironment. Using this model, we explored strategies to enhance chemosensitivity to doxorubicin, an important chemotherapeutic drug widely used for the treatment of hematological malignancies. Lymphoma cells grown in this model exhibited excellent biomimetic properties compared to conventional 2D culture including (1) enhanced chemotherapy resistance, (2) suppressed rate of apoptosis, (3) upregulated expression of drug

resistance genes (MDR1, MRP1, BCRP and HIF-1α), (4) elevated levels of tumor aggressiveness factors including Notch (Notch-1, -2, -3, and -4) and its downstream molecules (Hes-1 and Hey-1), VEGF and MMPs (MMP-2 and MMP-9), and (5) enrichment of a lymphoma stem cell population. Tiam1, a potential biomarker of tumor progression, metastasis, and chemoresistance, was activated in our 3D lymphoma model. Remarkably, we identified two synergistic therapeutic oncotargets, Tiam1 and Notch, as a strategy to combat resistance against doxorubicin in EL4 T and A20 B lymphoma. Therefore, our data suggest that our 3D lymphoma model is a promising in vitro research platform for studying lymphoma biology and therapeutic approaches.

O016

Protective Effects of Fish Collagen Peptides against CoCl2- and TNF-α-Induced Cytotoxicity and Inflammation in HaCaT Cells via Suppressing ROS/MAPK/NF-κB Pathway

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Skin diseases associated with inflammation or oxidative stress represent the most common problem in dermatology. The present study demonstrates that fish collagen peptides (FCP) protect against CoCl2-induced cytotoxicity and TNF-α-induced inflammatory responses in human HaCaT keratinocyte cells. Our study is the first to report that FCP increase cell viability and ameliorate oxidative injury in HaCaT cells through mechanisms mediated by the downregulation of key pro-inflammatory cytokines, namely, TNF-α, IL-1β, IL-8, and iNOS. FCP also prevent cell apoptosis by repressing Bax expression, caspase-3 activity, and cytochrome c release and by upregulating Bcl-2 protein levels in CoCl2- or TNF-α-stimulated HaCaT cells. In addition, the inhibitory effects of FCP on cytotoxicity and the induction of pro-inflammatory cytokine expression were found to be associated with suppression of the ROS, MAPK (p38/MAPK, ERK, and JNK), and NF-κB signaling pathways. Taken together, our data suggest that FCP are useful as immunomodulatory agents in inflammatory or immune-mediated skin diseases. Furthermore, our results provide new insights into the potential therapeutic use of FCP in the prevention and treatment of various oxidative- or inflammatory stress-related inflammation and injuries.

O017

Neural crest-derived facial dermis in mouse has distinct tissue architecture

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Skin of the face is indisputably different from the skin of other regions of the body. For example, it is highly innervated and vascularised, and anecdotally superior in wound repair and regeneration. However, there is scant cellular and molecular information to explain these differences. Regional differences in skin emerge during development and are imparted by the dermis, which has a complex developmental history as it arises from different embryonic populations. Specifically, face dermis is derived from neural crest, whereas back dermis is derived from paraxial mesoderm, and the abdomen dermis from lateral plate mesoderm. To address our hypothesis that positionally distinct dermal features reflect the developmental origin of the tissue, this project characterised and compared dermis architecture of face, abdomen and back skin, three sites representing the three developmental precursors.
We first questioned whether normal adult dermis retains a transcriptional signature reflecting its developmental origin by profiling tissue from

three anatomical sites by RNAseq. Results showed divergence and hierarchical clustering echoing the developmental histories. Functional classification of the differentially-expressed genes revealed the extracellular matrix (ECM) to be particularly dissimilar in facial dermis. Histological analysis of the dermis through development equally indicated differences in ECM architecture. Further evidence of distinct ECM compositions across sites was revealed by tissues having variations in susceptibility to enzymatic degradation. Assays to quantify collagen content confirmed that the cheek dermis has different characteristics, specifically having the highest proportion of soluble-to-insoluble collagen. Finally, primary dermal fibroblasts cultures from the three sites were used to generate cell-derived matrices; cheek fibroblasts showed distinctive ECM arrangement (finer and more intricate) in line with the histological differences. Advances to our understanding of the molecular and behavioural characteristics of the dermis are anticipated to inform improvements to wound healing and regenerative medicine in the future.
Ethical approval was not required.

O018

Survivin – plausible tumor biomarker in colon adenomas

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Antiapoptotic protein survivin plays an essential role in negative regulation of apoptosis. It is widely expressed in the most human cancers and also in premalignant entities. Due to large quantitative differences in survivin expression degree in normal adult tissues and in corresponding premalignant and malignant lesions as well as different subcellular compartmentalization, survivin appears to represent a promising tumor biomarker and a prognostic factor.
Using immunohistochemistry, we examined survivin expression pattern in 116 colorectal adenomas to determine its association with clinicomorphological parameters such as age of patients, adenoma size, degree of dysplasia and localization. In each section, the subcellular localization of survivin and the immunoreaction intensity were assessed.
Overall, protein in question was expressed in 90 cases (77.6%), cytoplasmic localization was found in 46 cases (39.7%), nuclear together with combined nuclear and cytoplasmic localization in 44 cases (37.9%). Low grade dysplasia was diagnosed in 64 cases (55.2%) and high grade in 52 cases (44.8%). χ^2test confirmed that the presence of survivin expression significantly correlated with the adenoma size and dysplasia grade. However, correlation with the age and adenoma localization was statistically insignificant. As for the survivin distribution, results revealed that survivin subcellular localization significantly correlated with the lesion size, dysplasia grade and tumor localization. Based on the Cochran-Armitage test for trend, we confirmed a statistically significant trend between survivin immunoreaction intensity (weak/strong), dysplasia grade and localization of the adenoma. Immunohistochemically, subcellular survivin location may represent the most promising diagnostic, differential-diagnostic and prognostic biomarker which should be introduced in histological evaluation of colorectal adenomas.
This work was supported by VEGA grant 1/0129/16.

O019

Altered activity of Wnt/β-catenin and BMP pathways in chick embryos and alternative splicing of Dlx5 result in skeletal phenotypes in cerebro-costo-mandibular syndrome

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Although the spliceosome is required for the transcription of most of the genes in our body, the phenotype of spliceosomal defect syndromes is largely limited to specific tissues such as the bones, retina, brain and motor neurons. Cerebro-Costo-Mandibular syndrome (CCMS) is an example of one of these spliceosomal syndromes, a congenital skeletal disorder caused by mutation of SNRPB, encoding small nuclear ribonucleoprotein polypeptide B/B'. CCMS is characterised by discontinuity of ribs, called rib-gaps, at the posterior part of the shaft, along with scoliosis and craniofacial defects such as micrognathia, glossoptosis and cleft palate. In vitro, SNRPB knock-down decreases cells' sensitivity to the Wnt/b-catenin pathway while increasing cells' sensitivity to BMP signals. Local modification of activities of these pathways in somites in vivo recapitulated posterior rib-gap phenotypes in the costal cartilage in model chick embryos. Ethical approval for the use of chick embryos in these experiments was obtained from the University of Bristol. Further knock-down of SNRPB in osteoblast-like cells SaOS-2 attenuated upregulation of Runx2, ALP and Osterix that are required for bone matrix deposition in osteogenesis. It was also found that this was due to alternative splicing of Dlx5 in knock down cells, a gene that crucially initiates and maintains Runx2 expression for osteogenesis, to form a non-functional, truncated version. These results suggest that altered activities of Wnt/b-catenin and BMP pathways and splicing defects of specific genes contribute to the phenotype in CCMS.

O020

Micro Teaching in Anatomy: Principles, Procedures, Benefits and Limitations

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The use of Near-Peer Teaching (NPT) is well integrated in anatomy education at the University of Southampton. Within the head and neck module this initiative aims to improve students' engagement and learning in both a laboratory and lecture setting, by deploying student (peer) teachers to aid in delivering the material. The sustainability of the programme has been ensured by the development of a training regimen. An important component of this process is microteaching; a session where students deliver small lessons with immediate feedback on content and delivery to facilitate reflection and improve skills. The aim of this study was to evaluate the effectiveness of microteaching as a tool to train NPTs.

We have run an annual microteaching day for 4 years. Students prepare and deliver a 10-minute presentation, during which they are evaluated by experienced NPTs, their peers, and faculty teachers. After receiving feedback, they are given the opportunity to re-deliver the session in the afternoon to different assessors and implement improvements.

The success of the teaching was measured using a 5-point Likert scale (1=Very Poor, 5=Excellent), using 11 criteria. The students' morning and afternoon scores were compared (n=440). Analysis showed a significant increase in scores across all criteria when comparing the morning to afternoon sessions ($p < 0.0001$), with the least significant difference being in 'teachers' enthusiasm' ($p < 0.001$). The largest disparity in scores was witnessed in "student's use of learning objectives" criteria.

This study has demonstrated that microteaching is an effective way of enhancing teaching skills for NPTs and is viewed as a process of validation for its continued application. However, complementary training approaches are required to address areas of development in which

microteaching is less effective such as use of body language.
This study was approved by the Faculty of Medicine Ethics Committee University of Southampton.

O021

New fixation method in anatomy: polymerization

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Anatomists use human bodies and organs as educational tools. One of the most important prerequisites for the use of human bodies in educational settings is the appropriate preservation of the cadaver. This is achieved by treating the cadaver with special chemicals. One of the most important chemicals used for this purpose is formaldehyde. Because of the formaldehyde vapor has an unpleasant smell and harmful effect on the health of the users, the alternative methods have been the matter of the researches. We aimed to prepare the rat organ specimens with "polymerization method" which can be adaptable to human organs due to similar cellular architecture.Rats were deeply anesthetized with a ketamine/xylazine and transcardially perfused with a monomer mixture solution(stock solution; acrylamide(40%),bis-acrylamide(2%),VA-044 initiator(10% wt),10XPBS,16%PFA in dH_2O).Brain, heart, lung, spleen, and liver were removed and placed in the same solution overnight at4°C.Then O_2 was removed from the tube containing samples as O_2 impedes hydrogel formation and the temperature increased. Polymerization of the tissues was completed in 4h and the organ specimens were ready for long term use. The most important advantage of this technique is to prevent inhalation exposure to formaldehyde of students and lecturers. This technique has several advantages compared to formaldehyde fixation, such as the use of dry, odorless, and durable educational materials. In contrast to other polymers, cross-linked polymers are mechanically stable, resistant to heat, and attack by solvents; therefore, once it is formed, it can be used for a long time. Furthermore, after a lipid extraction process, organ specimens prepared with this technique are optically transparent and allow examining with microscopes which use optical sectioning. The significant drawbacks of this technique are that the chemicals used for polymerization are expensive and the polymer structure of the tissue causes dissection difficulties. However, tissue prepared with this technique is quite useful for cross-sectional anatomy as it allows slicing without deformation.
This work was supported by TUBITAK(114S407).All procedures approved by the Pamukkale University Ethics Committee for Animal Care and Use(PAUHADEK-2013/027).

O022

Standardized Reduction of Formaldehyde Emissions below the WHO Threshold of 0,1mg/m³ During Dissecting Courses

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The reduction of formaldehyde emissions during student dissecting courses has been a difficult long-term task. Changing concentrations of the preservation fluids did not effect a reduction.
We are exclusively working on the improvement of anatomical techniques and developed a system which guarantees the reduction of formaldehyde emissions below 0,1mg/m³ in the breathing zone of students, lecturers and medical staff. This emission rate is also the threshold recommended by the WHO.
The system which made these low rates possible is a purely technical one by a combination of correct air flow / volumes with a low velocity in combination with specially designed, downdraft extracted dissecting tables and fresh air supply from above (laminar flow). At our development programme we used 3-4% formaline. The original formaldehyde emission rates were far above 0,37mg/m³ (which is the border value in Germany) and with our system the emissions came down to 0,07mg/m³.

The air-change in the dissecting room was with 8 times per hour sufficient. The final noise level was 55db(A). Uncomfortable air-draft was not present.
The presented system has been tested and protocolled by the institute of Hazardous Material Research in Bochum / Germany at a dissecting course with 100 students present. In result, the university anatomy department received the official operating license from the Health & Safety authorities after the dissecting department had been shut down due to exceedance of the formaldehyde emission threshold.
A prerequisite for eliminating all formaldehyde problems is that the institute will be equipped with special extraction dissecting tables, a fresh air supply system above each table, and a professionally planned in-house air extraction system.
Our R & D efforts resulted in the aforementioned system which can be installed within any anatomy dissecting department so that the hazards of formaldehyde in anatomy are banned and eliminated for good.

O023

Alterations in the extracellular matrix in the obese human term myometrium

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Poor uterine contractility and dysfunctional parturition are with increasing BMI in pregnant women. Any alteration in extracellular matrix (ECM) composition can result in abnormal mechanotransduction and cellular sensitivity to mechanical stress, possibly leading to impaired contractility. The maintenance of structural integrity and“firmness” of the tissue are dependent on collagen fibres.
Stereological methods were employed to examine the organisation and distribution of the collagen fibrils in human myometrium. This study had patient consent and full ethics committee approval. 3 groups of women were sudied: Obese pregnant women (n=5), Normal (BMI) pregnant women (n=5) and Non-pregnant women (n=4).
Myometrial samples from these women were processed for electron and light microscopy.
Stereological techniques were employed to assess the following parameters: No. of collagen fibrils per unit area (Na), Length volume per unit are (Lv) and spacing of collagen fibrils in three zones in the extracellular matrix: inner (closest to SMC), middle and outer in TEM micrographs from each group.
The results revealed significant differences in all parameters between all groups, particularly in the inner zone ($p<0.05$). The collagen fibres were more densely packed in the obese groupthan in the non-pregnant group suggesting a “stiffer” myometrium.
Atomic force microscopy and Confocal Raman spectroscopy were also used to examine the physicochemical properties of the ECM Roughness was significantly higher in the ECM of normal individuals ($p=0.034$). Major peaks at relative Raman shifts (cm-1) of 972, 1000, and 1035, corresponding to collagen, phenylalanine, and collagen, were present at much greater intensities in the ECM of normal mothers.
These studies indicated an alteration in the ECM microenvironment surrounding the SMCs in maternal obesity. This may be a factor affecting the activation of mechanotransduction and biochemical signalling pathways which ultimately modulate myometrial contraction.

O025

Form and Function of the Dolphin Clitoris

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In some species that copulate year-round, such as humans and bonobos, sex is known to be pleasurable for females. Dolphins copulate throughout the year, largely to establish and maintain social bonds. The anatomy of the dolphin clitoris has not been well described and its functional capacity is unclear. We assessed

how the clitoris is built and the potential for erectile tissue to expand during copulation in common bottlenose dolphin (Tursiops truncatus). Excised clitorises were collected opportunistically from naturally deceased post-mortem females and used in: 1) gross morphological dissections, 2) micro-computed tomography scans, or 3) paraffin histology and staining. The clitoris is large, well-developed, and positioned at the entrance of the vaginal opening where it can directly contact with the penis during copulation. Two separate bodies of extensive erectile tissue of the corpus cavernosus merge into a single body near the clitoral hood, and are surrounded by a thick tunica albuginea, similar to the human clitoris. The erectile tissue is surrounded by smooth muscle and fibromuscular dense connective tissue. There is an abundance of large axon terminals close to the skin, suggesting the clitoris is highly sensitive. The skin around the clitoral hood is thin, wrinkled, and folded, suggesting the possibility of expansion during engorgement. Our anatomical observations suggest the clitoris may be functional in bottlenose dolphins, but further research, including physiological and behavioral analyses, are necessary to test if sexual experiences can be pleasurable for female dolphins.

O026

Visual anatomy in the Igbo Cosmology: An Insight into the Anatomo- Religious impressions of the Ikenga

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The artwork ikenga is a sculptured piece of a sitting male youth with arms flexed at the elbow, the forearm resting on the thigh and the hand in a supine position. The right hand is carrying a machete while the left is carrying a small earthenware pot. Among the Igbo and Igala sculptors of Nigeria where ikenga is endemic, a lot of similarities are observed in stylistics; however some structural variations occur. In Igbo mythology, the ikenga is associated with the spirit of the personal god, chi which is the link to the supreme God Chukwuokike. Forty art collections of the ikenga were examined.Twelve (40-70cm in length) were collected from Ogbaja Onu-ata while 28 (60-120cm) were observed from Nigerian National Museum, Enugu. They were digitally photographed and topographically examined for relative body dimensions. The works were analyzed noting the style of the early sculptors and how they can be attributed to advances in the sculptors' knowledge of human anatomy. The artistic impressions conveyed by the ikenga showed human anatomy very profusely rendered, an indication that anatomy was paramount in the Igbo statuary. Anatomical impressions paramount in the ikenga imagery include: the clear recognition of the indentations of the rectus abdominis, the observed curvatures of the deltoid muscle; and a fair appreciation of the positions of the sternocleidomastoid and the trapezius muscles in the sculptured neck. Although ancient Igbo sculptors presented works with less body proportionality especially with exaggerated head and ears, it could be deduced from anatomo-religious perspectives that the ikenga imagery is explicitly oriented to male power and accomplishment which is to convey the image of the personal god, chi. Hence the ikenga power is structurally depicted as many and complex and reflect the nuances of masculine ethos.

O027

Neuroanatomy and Art

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Neuroanatomy has been studied in detail since centuries not only by anatomists but also by others with varying interests. There is a strong connection between Renaissance artists and neuroanatomy. The author would like to explore this in detail.

The following four European artists' work with regard to neuroanatomy has been studied and examples with interesting findings selected to highlight their understanding. Its correlation in life outside medical science is also exhibited.

Leonardo da Vinci (1452 – 1519) in his "search for the soul" used myriad of innovative methods acquired from his knowledge of painting, sculpture, and architecture to define more clearly the site of the "senso comune" anatomically.
Gerard David (1460 – 1523) was a Flemish artist who is known for his famous painting 'Transfiguration of Christ' mimicking GOD in the III ventricle and Jesus acting as a conduit between brain and the spinal cord.
Michelangelo (1475 – 1564) started dissecting human bodies at the age of 18. In his famous work 'Creation of Adam' the God resembles shape of human brain. Also in his painting 'Separation of Light from Darkness' there is resemblance to brain stem and the spinal cord.
Raffaello Sanzio da Urbino (1483 – 1520) was the third amongst the Italian 'Trinity of Masters' having worked for two Popes in Rome. He was enormously productive and his painting of 'Transfiguration of Christ' also shows resemblance to anatomy of brain.
Most fascinating facts are revealed as we study their work and it helps us to understand the evolution of our knowledge about neuroanatomy as we trace back to Renaissance. There are various postulations about their work and depiction of neuroanatomy therein.
Neuroanatomy has been a subject of interest for long time and understanding it from a different perspective is intellectually highly stimulating.

O028

New viewpoint of surface anatomy using the curved sectional planes of a male cadaver

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The curved sectional planes of the human body can provide a new approach of surface anatomy that the classical horizontal, coronal, and sagittal planes cannot do. The purpose of this study was to verify whether the curved sectional planes contribute to the morphological comprehension of anatomical structures.
By stacking the sectioned images of a male cadaver, a volume model of the right half body was produced (voxel size 1 mm). The sectioned images with the segmentation data were also used to build another volume model. The volume models were peeled and rotated to be screen captured. The captured images were loaded on user-friendly browsing software that had been made in the lab.
The browsing software was downloadable from the authors' homepage (anatomy.co.kr). On the software, the volume model was peeled at 1 mm thicknesses and rotated at 30 degrees. Since the volume models were made from the cadaveric images, actual colors of the structures were displayed in high resolution. Thanks to the segmentation data, the structures on the volume model could be automatically annotated. Using the software, the sternocleidomastoid muscle and the internal jugular vein in the neck region, the cubital fossa in the upper limb region, and the femoral triangle in the lower limb region were observed to be described.
For the students learning various medical procedures, the software presents the needed graphic information of human body. The curved sectional planes are expected to be a tool for disciplinary convergence of the sectional anatomy and surface anatomy.

O029

Using 3D photogrammetry to enhance the teaching of Human Anatomy: an evaluation

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Cadaveric specimens are still the most realistic and detailed resource for anatomy teaching, but their availability is limited due to their confinement to licensed facilities. 3D photogrammetry models of cadaveric specimens have shown potential to enhance the cadaver-based teaching of Anatomy, but as these are still a fairly new resources, there is the need for data on their benefits for learning. In this study we performed an evaluation of two learning

resources based on a 3D photogrammetry model of the human Circle of Willis to assess the students' views on the usefulness of these resources for their learning.

We created a high-resolution 3D photogrammetry model of a cadaveric human brain and Circle of Willis and, based on this model, two learning resources: 1) an interactive 3D PDF and 2) an annotated video. We then asked 100 undergraduate students of Medicine and Biomedical Sciences to explore these new learning resources and to fill in a Likert scale questionnaire. The study was approved by a Licensed Teacher of Anatomy.

Responses showed a clear preference for our digital 3D tools over traditional learning resources (e.g. plastic models or photographic atlases). Over 90% of the students agreed that our tools facilitate the identification of structures in cadaveric specimens and the creation of a mental 3D image of the anatomical structure. The majority of students was satisfied with the rotational speed and the timing of text labels in the video, but there is a tendency towards slightly faster rotations and slightly longer display of text labels in the students' preferences.

This positive student feedback encourages us to create more resources of this kind of other regions of the body. As a next step, we plan to translate the student feedback into our videos by adjusting the timing of rotation and display of text labels.

O030

Establishing and Applications of High Resolution Digital Human Sectional Dataset

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Clinical practice needs high resolution digital human body in order to reveal more detail anatomic structures. Our purpose is to obtain the high resolution sectional dataset of the human body by using digital freezing milling technique for establishing more precise clinical digital human.

4 Chinese adult cadavers were used. After CT and MRI examinations verification of absent pathological lesions, the specimens was embedded with gelatin in anatomical position and frozen under profound hypothermia, and the specimens were then serially sectioned from feet to head layer by layer with digital milling machine in the freezing chamber. The sequential images were captured by means of a digital linear scanning camera and the dataset was imported to imaging workstation. High resolution digital human bodies were created by using those dataset. The specific protocol of this study was approved by the Medical Ethics Committee of Shandong University.

The thin serial sections of the human body added up to more than 68 thousands layers with each layer being 0.1 mm in thickness. The picture resolution was 16000×26000. The data size of each section was 2.3GM. The shape, location, structure, vessels and adjacent structures of main organs were displayed clearly on each layer of the horizontal, sagittal, and coronal sections. The three dimensional models of some regional structures, for example, hand, were created according to clinical needs. The digital atlas of sectional anatomy was prepared at high resolution level for clinical imaging diagnosis.

The methodology reported here has greatly improved the milling methods previously described. It is a new data acquisition method for sectional anatomy and digital human study. The thin sectional anatomic dataset of human body obtained by this technique is of high precision and good quality for establishing clinical digital human with high resolution.

O031

Human prosections beyond the dissection room.

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Human cadaver dissection and prosection are defining elements of anatomy teaching. Typically, this takes place in dedicated spaces like dissection rooms and skills centers. At the same time, technological advances are rapidly reshaping the education landscape. Today's digital technologies allow dissection rooms and their collections to be visualized and digitized. This could have important benefits. From a societal point of view, it could offer a proven teaching model showing the genuine bodily complexity to academic institutes that lack a body donation program. For institutes having their own facility, it could provide benefits in terms of better occupational health, more efficient and impactful use of donated bodies, and more targeted use of the dissection room because of improved possibilities for anatomical self-study. Still, such initiatives are rare.

Here, we present a virtual dissection room targeted at biomedical students and professionals. The study was approved by the body donation program's ethical committee. From multiple prosections, thousands of high-resolution photos were taken. Photogrammetry was used to convert photos into 3D models. A dedicated application was built using a game-engine, and the digitized 3D-prosections were annotated using a digital sculpting program. Multiple dedicated dissections, and ten terabyte of data later, the authors believe to deliver a unique interactive 3D-prosection-atlas with unparalleled resolution and detail, while respecting the goals of the body donation program and donor privacy. We believe that instead of replacing existing dissection rooms, applications like this will strengthen them, exactly because of their resemblance to the actual specimens and the high potential for knowledge transfer. To achieve this, an appropriate educationalist design of the application is of paramount importance. We present our vision on how to build a photorealistic virtual dissection room, addressing ethical, technical, educational, and data security challenges.

O033

The Anatomical Core Syllabus in an Evolutionary Medical Curriculum

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Evolutionary Medicine is the application of principles of evolutionary and developmental biology to problems in human healthcare. As such it is broadly integrative, providing an empirically testable ontophylogenetic framework that readily incorporates the burgeoning informatics of modern medicine ranging from genomics to evolutionary psychology. The narrative of evolving human anatomy is foundational to Evolutionary Medicine. This "anthropogenic" historical perspective of structures makes anatomy understandable as a hierarchical simple-to-complex continuum of adaptations through time extending from cells to tissues to organs to systems. The anatomy that students dissect in the laboratory is understood to have been built ontogenetically upon homeotic-gene-driven development of differentiating body segments. They evolved in phylogenetic context as documented by paleontology and the molecular clock. Anatomical structures are understood to have co-evolved with functions that correlate horizontally with biochemical, immunological, endocrinological, and physiological adaptations. Such an integrated appreciation of structure affords future physicians a robust and theoretically sophisticated framework for effective differential diagnosis and ultimately enhances patient care.

The dilemma faced by anatomists embracing the Evolutionary Medicine paradigm as they design curricula is how to define the core information that should be learned within the allotted course time and still convey the desired breadth of understanding. Two authoritative compendia, both with avowed clinical relevance, are the IFAA Terminologica series (Anatomica, Embryologica, and Histologica) and the recommended core curricular objectives recently released by the

Anatomical Competencies Project of the American Association of Anatomists (Embryology, Gross Anatomy, Histology, and Neuroanatomy). Broad overlap in these two resources serve as a foundation for an evolutionary anatomy approach. Learning anatomical organizing concepts that enable critical thinking about structures and associated clinical entities should be emphasized over rote memorization of anatomical terms. Horizontal integration and Inquiry-based Learning reduce redundancy among courses. A regional dissection plan based on ontophylogenetics is well-suited to a systems-based curriculum.

O034

Virtual versus traditional collaborative learning experiences for anatomy education

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It has been suggested that virtual resources promote collaboration. This study investigated whether face-to-face collaboration is more effective using virtual or traditional resources in anatomy and evaluated the impact of prior anatomy knowledge and university experience. An interactive virtual heart tutorial was developed using Unity® and its impact on collaborative learning was compared to that of a traditional laboratory-based activity. Participants' perceptions were surveyed and attainment of learning outcomes, including knowledge change and new knowledge retained (post-pre/perfect-pre x100), were measured. A total of 182 voluntary participants (88 virtual, 94 traditional) took part in this study (UNSW Ethics #HC16592). Knowledge change was greater overall in the traditional activity, and in the virtual activity it was greater for participants with prior knowledge and for junior participants. New knowledge retained was similar overall for both the virtual and traditional activities, but higher for participants without prior knowledge in both activities and higher for senior participants in the virtual activity. Perceptions regarding interest and engagement, motivation, understanding and collaboration were higher overall for the virtual activity, higher for participants with prior knowledge for the traditional activity and significantly higher for junior participants for both activities ($p=0.019$, 0.005, 0.012 and 0.028, respectively). Motivation was rated significantly higher by junior participants for the virtual activity ($p=0.009$). In perceptions regarding collaborative learning, participants with prior knowledge and junior participants were significantly more likely to recommend both the virtual and traditional activities to others ($p=0.011$ and 0.030, respectively). Junior participants were also significantly more likely to agree that the activities allowed for teaching peers effectively ($p=0.021$). These results suggest that both virtual and traditional activities can be effective for collaboration, although prior knowledge and university experience should be considered when designing collaborative learning experiences and accounted for as confounding factors in evaluating educational technology.

O035

A Delphi Panel Approach to Develop a Core Syllabus for Teaching Histology to Medical Students

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There is a world-wide increasing trend for incorporating histology into the integrated medical curriculum with clinically relevant content. The goal of this project was to provide a guidance to the educators who are redesigning histology curriculum for medical students. To establish what material is appropriate for teaching medical students, a Delphi panel under the auspices of the International Federation of Associations of Anatomists (IFAA) was established. The members of the Delphi panel

were recruited from 13 different countries consisting of 20 basic science and clinical educators. The project is divided into two sections: (1) Cell and basic tissue and (2) Organs. Based on literature review 588 topics were selected and sent to the panel members for review. In the first round of review, each topic was rated by the panel members as being “Essential," "Important," "Acceptable," or "Not required," based on core knowledge, its clinical correlations and cellular/molecular content that could be relevant for teaching histology. The members provided their ratings with comments and suggestions for additional topics. In the second round, a list of core items expected students to learn was provided by the members, and additional suggested topics were reviewed and rated by the panel. A total number of 726 topics were reviewed, including 257 (35.4%) original items in the Cell and Basic Tissue section and 331 (45.6%) in the Organs section. Additional items recommended by panel accounted for 138 (19.0%). In summary, the Delphi panel approach with members across multiple countries, and approved by the IFAA, the project does not meet the definition of human subjects research. It is an initial stage in the development of a list of important and clinically relevant topics for histology educators, which could serve as a foundation for further development of international standard of a core syllabus for teaching histology.

O038

The evolution of an evidence-based blended learning subject in anatomy

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Blended learning, involving a combination of online and face-to-face (F2F) learning, has potential benefits for students, but the transition to a blended format requires significant input from academic staff. This project sought to realize the potential benefits of blending delivery in a way that responded to technological advances, geographical and student cohort challenges and was successful for students (both academically and qualitatively) but with a sustainable staff workload. The process involved a series of incremental changes, each rigorously evaluated in studies approved by the University Human Ethics Committee.

The implementation of an online learning management system (LMS) allowed the incorporation of asynchronous staff-mediated discussion forums and the development of online video content to replace some lectures, while retaining F2F practical classes. This initial blending of the subject overcame some of the challenges of running the subject across two campuses, resulted in the maintenance of very high student satisfaction and enhanced students’ academic outcomes. The sustainability of the transition was largely because of a rigorous peer-reviewed approach to the development of all online content.

The addition of a second cohort of academically weaker students to the subject necessitated major scaffolding support to cope with the bimodal distribution of grades and decreased success rates. A suite of solutions incorporating team-teaching (including near-peer mentors), extra tutorials and compulsory pre-practical activities was partially successful in overcoming this challenge. More recent blending additions, currently under evaluation, have been to replace all remaining F2F lectures with online content. The previous F2F allocation is now dedicated to small group interactive sessions to facilitate student learning by linking online content to anatomical principles.

The evidence-based approach of evaluating incremental curriculum changes has been critical to the transition from fully F2F teaching to blended learning in a way that has been successful for students and sustainable for staff.

O039

Dissecting Anatomy; the Lived Experience

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Anatomy is an important component of pre-registration healthcare courses, and much research has been undertaken into how and when it is taught and assessed, largely measured in terms of student performance. No such research base exists regarding the student perspective of this experience. This study used the lived experience of podiatry students when learning anatomy, and applying and developing that learning in clinical practice, to gain insights into the phenomenon of learning and applying anatomy.

The study was conducted using a descriptive phenomenological methodology. Ethical approval was granted by the School of Health Sciences ethics panel. During a three year pre-registration programme, students consented to be interviewed following the completion of their first year anatomy module, after two scheduled final year clinical sessions, and after a learning encounter in the dissection room.

Analysis of the interview data revealed the structure of the phenomenon to consist of eight constituent parts: 1) assuming a learner-ready attitude, 2) employing patterns of behaviour, 3) (de)constructing anatomy, 4) a sense of reality for or from practice, 5) solving clinical problems, 6) working alone, with resources, and through and with others, 7) recognising (in)competence in self and others, and 8) reflecting and acting on experience. The constituent parts have been formulated into a model of learning anatomy. The model shows that the student experience of learning and applying anatomy is a process comprised of three overlapping sequential stages: making sense, making meaning and working with meaning, and is mediated by reflection.

These findings will help teachers of anatomy to facilitate learning. Recommendations are made for anatomy teaching and learning practices in both theory and clinical settings. The recommendations will help to enable students to make sense, make meaning, work with meaning, and develop their skills of reflection throughout their education for professional clinical practice.

O040

Anatomy learning preferences of UK medical and anatomical sciences students

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Medical schools in the UK continue to face the dilemma of fitting expanding content in many subject areas into an increasingly overloaded medical curriculum. National guidelines for core content requirements exist, whereas detailed curriculum design and teaching methods in individual medical schools vary. Several factors have caused anatomy, and human cadaveric dissection experience particularly, to become a target for cuts in many medical schools. Similarly, not all UK anatomical sciences students learn human anatomy through cadaveric dissection. In both cases, approaches to the redesign of anatomy teaching have aimed to incorporate more efficient teaching methods. The investigation of student attitudes towards this expanding repertoire of methods is pivotal to maintain high educational standards and a positive student experience.

This study aimed to investigate preferences of students learning anatomy at three institutions with differences in their anatomy teaching methods. Ethical approval was obtained from all participating universities, and informed consent was given by subjects prior to their participation. Anatomical sciences students at the University of Aberdeen learn anatomy with prosections, whereas teaching to medical students at the University of Dundee and Cardiff University incorporates both cadaveric dissection and prosections. All three universities supplement anatomy teaching with didactic teaching, computer-based learning resources, plastic models and textbooks.

Learning preferences of UK medical and anatomical sciences students appeared to be similar to the resources to which each participating cohort was most exposed. All cohorts ranked cadaveric resources as their favourite way to learn anatomy. Cardiff and Dundee students preferred dissection over other

approaches, whereas Aberdeen students ranked prosections as their favourite learning method, with dissection second, despite their learning being exclusively with prosections. Computer-based resources were also ranked favourably by all cohorts, whereas textbooks and didactic teaching appeared least popular. Learning with cadavers therefore still seems to be relevant to today's students of anatomy.

O041

Embalming methods and learning: a student perspective on the transitions between formalin and Thiel embalmed cadavers on a dissection course

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Most dissection-based programmes around the world use formalin-embalmed cadavers but other embalming techniques are gaining traction. Thiel embalming maintains colour and tissue flexibility. Hull York Medical School (HYMS) uses a combination of formalin and Thiel-embalmed cadavers for full-body dissection in the MSc in Clinical Anatomy (and Education). This study aimed to identify the perspectives of students on these programmes regarding the transition between the two embalming methods, and their preferences for learning different anatomical regions. Ethical approval was granted by HYMS Ethics Committee.

In 2016/17, students dissected musculoskeletal (MSK) structures on formalin-embalmed cadavers, then trunk on Thiel. In 2017/18, the embalming method for these regions was switched. Reflective learning portfolios from 2016/17 (n=15) and 2017/18 (n=14) MSc cohorts underwent thematic analysis around the experience of dissecting Thiel and formalin-embalmed cadavers. A questionnaire using Likert-scale and based on themes identified in portfolios was completed by 12 students (2016/17 n=4, 2017/18 n=8).

In each cohort, the transition elicited an increase in the number of references to the embalming method in portfolios, however this was markedly higher when transitioning from formalin to Thiel (11.2-fold) than vice versa (3.2-fold); most of these extracts were coded to 'emotion'. The realness of Thiel and the associated emotional response was more apparent after working with formalin, a baseline context that was lost when starting dissections with Thiel. For MSK learning, Thiel improved functional anatomy learning experience ($p<0.05$), whereas formalin allowed easier identification of structures in the trunk ($p<0.05$).

Overall, Thiel was preferred for MSK due to structural flexibility, and formalin for trunk due to the structural integrity of the viscera. Interestingly, there was a greater emotional response to Thiel which students felt helped them to learn; this may be attributed to increased lifelikeness of Thiel-embalmed cadavers and the perceived increase in clinical relevance to their anatomical learning.

O042

Integrating the Anatomage Table into an Anatomy Curriculum: a qualitative analysis of Medical student perception of the barriers and enablers

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The absence of cadaveric dissection or prosection in the Medical programme was a conscious decision to constructively align teaching to the clinical experience of patient interactions, via surface anatomy and medical imaging. Innovative pedagogy and the incorporation of techniligy into the anatomy curriculum allows students to add complexity in a spiralled curriculum, yielding high student satisfaction. The Anatomage virtual dissection system offers an additional modality to explore anatomy, with a depth of detail rivalling cadaveric approaches.

This study aimed to understand student perception of the Anatomage system and factors affecting their engagement with it, to inform curriculum design and learning tools to enable effective use of the Anatomage system.
This study utilised thematic analysis directed by grounded theory. Focus groups included 6-10 year 1-2 students providing detailed narratives to be gathered for analysis. Thematic analysis began with an inductive approach, based on the focus group data, followed by a deductive approach, grounded in an understanding of the relevant literature and prior experience, which informed the coding. Ethical approval was granted by the Faculty Research Ethics Committee
Four main themes emerged from the narratives: the educational value of the table; the timing of use; learning to use the table; group dynamics. Students appreciated that the system aids their learning. They found it easier to start with surface anatomy or plastic models before progressing to the Table as they sometimes struggled with spatial awareness. Students raised the learning curve involved in using the system and the fear of breaking it, suggesting the need for more training. Group dynamics affected their engagement with virtual dissection, particularly with a dominant member, or mixed ability group.
This study has helped inform curriculum design and develop material to help students make the most of the Anatomage system to develop their Anatomy understanding.

O043

Skill acquisition is a vital part of histology education

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Histology is a content-heavy subject that students traditionally struggle to engage with and progress beyond surface retention. Histology forms a core part of the Medical curriculum at Keele University and provides a link between the study of gross anatomy and physiology, and prepares the students for the future exploration of pathology.
Many institutes focus on content provision over skill acquisition for anatomy-based subjects such as histology. This project focused on developing the students' ability to apply their knowledge as a means to improve their understanding of the microscopic anatomy of tissues.
Students were provided with a decision tree to encourage them to ask informed questions when identifying tissues in histology practical classes. This provided a concise map of all the tissues studied and showed the students how to categorise the tissues via key structures, therefore promoting the link between structure and function.
Students were also provided with online worked examples which showed the students how to use the decision tree to apply their newly acquired skills to novel scenarios, and online quizzes encouraged the students to test their understanding. Immediate feedback on the quizzes allowed students to learn from the formative assessment.
Data was acquired through anonymous online questionnaires, field notes by the researcher and summative exam results. Students found the decision tree helpful in their histology practical sessions as it provided a structured framework for the consolidation of knowledge, and showed them how to apply this knowledge (free-text comments). Formative quiz scores improved following use of the decision tree and online worked examples. Summative exam results also improved following use of the website when compared to the control group (previous cohort).
Ethical approval was sought from the student project ethics committee (SPEC).

O044

Thematic Analysis of Year 1 Medical Humanities Projects

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Medical humanities provide an interdisciplinary approach to medical education that draws on the creative and intellectual strengths of these two diverse disciplines. As part of the medical curriculum, medical students undertaking a cadaveric dissection course are required to

complete a medical humanities project in which they write, or create, a brief piece of prose, poem, music or piece of art that expresses their feelings, and gratitude, toward their anatomy donor and/or to issues of mortality. The collection of work produced by the 2018/19 cohort (n= 306) was analysed for themes and coded using Nvivo software. The most common words used in their pieces was 'thank' (1.8%), 'knowledge' (1.6%), 'life' (1.3%), 'donor' (1.2%), 'body' (1%), and 'gift' (1%). The most frequent images created depicted 'hands' and 'nature', many of which featured flowers and trees. Hands were commonly reported as being the most important part of the body for touch and interaction with others, while flowers and trees were used to represent the idea that our bodies are beautiful but not immortal. In addition, a random selection of 20 pieces were coded in depth for recurrent themes. Where 'knowledge', 'gift', 'a journey or future', and 'teachers' featured prominently. Students reported that they valued the knowledge they obtained and that they reflected on the impact that the experience will have on their future medical career. The opportunity for students to produce a creative piece of work dedicated to their anatomy donor is believed to help them communicate effectively and reduce detachment. Through semi-structured interviews with students, future work will investigate why these themes arose and how it helped them to process their dissection experience.

Being an evaluation, ethical approval was not required for this work.

O045

The Voice of Education: Gender, age, and ethnicity bias in students' evaluation of instructors in the digital learning environment

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Due to ongoing health sciences curricular changes and rapid technological advancements, students' learning experience and relationship with instructors are transforming from didactic classroom to an asynchronous digital environment. Despite these changing dynamics, instructor effectiveness is still largely assessed by students' evaluations, although mounting evidence suggests that evaluations are subject to implicit bias therefore unreliable measure of professional performance. Given the increasingly digital educational interactions, this Internal Review Board-approved, multi-institutional, single-blind study aimed to assess whether, in a digital learning environment, students' age, gender or ethnicity bias; 1) are apparent, 2) impact learning, and 3) affect the digital instructor evaluations. For gender and age bias, four experimental digital learning modules were created, containing the identical anatomy learning objects and scripts, but individuals of different gender and age narrated each module. For ethnicity bias, four digital modules with identical content were narrated by a single male, in four different accents. Students were recruited from ten undergraduate, graduate, nursing, dental and medical schools. Total of 371 participants completed the study. Learning outcomes were assessed by pre-test vs. post-test comparison (repeated measures MANOVA), and bias in instructor evaluations was assessed by repeated measures MANOVA and three-way MANOVA. In all experimental conditions, post-test scores increased significantly and uniformly regardless of the instructor's gender and age or ethnicity ($P<0.05$). The instructor evaluation, however, was the lowest for the older female instructor in the two dental schools for characteristics such as enthusiasm and knowledge ($P<0.05$), though this result, was not replicated in the undergraduate and graduate population ($P>0.05$). Ethnicity bias was observed with the Indian and Chinese accents receiving

higher evaluation scores for items such as organization and logical presentation, compared to the American and British accents ($P<0.05$). This study highlights the complex and evolving nature of implicit bias and its impact on learning and instructor evaluations.

O046

Candidate perspectives on MRCS examination preparation

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The Membership of the Royal College of Surgeons (MRCS) examination is an integral part of the curriculum for the Early Years of Surgical Training, and is a requirement for progression to higher surgical training in the UK. The examination tests candidates over a broad range of surgical conditions and applied surgical anatomy and pathology. Candidates are very much self-directed in their preparation for the anatomy component of the examination and there is a range of different media available to enable aspiring surgeons to prepare. We present two surgical trainees' experience of learning anatomy in preparation to sit the MRCS.
Mr Adam Gwozdz is a graduate of University College London where anatomy is taught during pre-clinical years through a combination of full dissection, prosection specimens and computer simulation. In preparation for the MRCS, Mr Gwozdz used the eMRCS online question bank, attended a revision course with anatomy teaching provided by Mr Harold Ellis and taught anatomy dissection to medical students during his Core Surgical Training (CST) in London. Miss Adeline Rankin is a graduate of Norwich Medical School (NMS) and undertook the MRCS examination during CST. Undergraduate anatomy teaching at NMS is delivered mainly through dissection-based seminars in the first three years. Miss Rankin attended anatomy revision courses, cadaveric surgical training practical workshops, informal study sessions provided by the RCSE and used online media such as teachmeanatomy.com and YouTube to prepare for the examination.
The experience of these trainees shows that anatomy teaching in Early Years Surgical Training is not standardised across the UK and varies depending on region.

O048

Flipping the Classroom: exploring the effects of a flipped approach on knowledge gain and student perceptions within a neuroanatomy near-peer teaching programme.

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Recently medical education has moved further from 'traditional' teaching methods to approaches that encourage independent learning, such as the Flipped Classroom. Used independently, the Flipped-learning approach has been shown to enhance learning and understanding, much like Near Peer Teaching (NPT). The benefits of both approaches are well researched. Combining them may optimise student outcomes, yet the literature in this area is limited. This study aims to explore the impact of a flipped approach method to teaching neuroanatomy in NPT.
In 2018, Southampton Medical School 2nd year students (n=215) attended a NPT session on cranial nerves by 3rd year NPTs (n=10). This was their first exposure to the topic. Half the cohort were taught didactically whilst the other half were given pre-reading material and taught via a Flipped approach. The students were blinded and

completed a pre-teaching test, post-teaching test and perception survey (response rate = 75.3%)
Analysis showed a significant increase of 0.81 marks in mean post-teaching scores (p=0.03) when comparing flipped to didactic teaching. However, of the Flipped group, only 38.2% engaged with the pre-reading material. Perception survey analysis revealed that students taught via the Flipped approach ranked their knowledge as significantly higher both before and after teaching (p<0.001) and felt NPT's devoted more time to areas they 'struggled' with. All other perception criteria tested yielded no significant differences.
This cohort study demonstrated that students benefit from increased academic performance when employing the flipped learning approach. Flipped-learning students correctly perceived their knowledge level to be greater compared to the didactic group. Their understanding of their own knowledge before teaching allowed students to identify deficits in understanding for them to address with the NPTs. This would suggest Flipped-learning is a viable strategy to optimise NPT delivery within the curriculum.
This study was approved by the Faculty of Medicine Ethics Committee.

O049

Similarities Between Veterinary and Human Medical Curricula and Educators

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Despite human (HUM) and veterinary (VET) medical institutions sharing the goal of educating the next generation of clinicians, there is little communication between them regarding curricular and pedagogical practices. The aim of the current study was to gather data about curricula, pedagogical methodologies, student populations, and training of anatomy educators at both HUM and VET institutions worldwide. We hypothesize that these two types of institutions do not differ significantly in these aspects. With IRB approval, a survey examining anatomy curricula and educators' backgrounds was sent to anatomists internationally, and 156 viable responses were received. In addition, general curriculum criteria between 35 institutions that have both HUM and VET schools were analyzed, including evaluation of courses offered, admissions criteria, and student demographics; approximately 50% of these curricula have been evaluated to date (April 2019). Descriptive statistics and Mann-Whitney U tests were used in analyses. Most parameters (when applicable) were similar between HUM and VET, including median anatomy faculty:student ratios (1:23), anatomy assessment methods, preclinical and prerequisite coursework, and state residency status and GPA (overall and science) for matriculating students. The educational background of anatomy educators was identical with one exception: 54.1% of VET faculty had a clinical degree compared to 9.2% of HUM faculty, which questions the importance of individuals teaching in clinical curricula holding clinical degrees. Median HUM class size was significantly larger than VET (p=0.002). The percentage of females enrolled in VET institutions is significantly higher (76% vs. 41% in HUM). The median total number of applications, and applicants per class seat, were significantly higher in HUM compared to VET (p<0.001), which challenges the long-standing assumption that the VET application process is more competitive. Thus far, the similarities between the education of HUM and VET medical students indicate that more collaboration can occur to better educate both student populations.

O050

Study Preferences in Anatomy Education: Geographical Differences among Turkish Medical Students

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Anatomy has been taught for centuries and it has evolved greatly along with its sources and methods of education. Many variations occurred in anatomy education all around the world. Researches mostly focused on what is the best teaching method for students, instead of what is the best studying method for them. This study aims to identify the study preferences of medical students from different regions of Turkey in terms of study methods and sources.
1998 medical students participated in the study. 1954 of the participants responded the questions. Participants were asked questions related with their way of studying anatomy; including time spent for studying, preference for a group or individual study, study materials, study methods. Descriptive statistics for categorical variables are given with frequency and percent and categorical independent data were analyzed with Chi-square tests. Local ethics committee approved the study.
Six out of 7 regions of Turkey were represented by students from 35 medical schools in Turkey. Preference for studying alone in southeast region (53,1%) were lower than the other regions and the differences were statistically significant ($p<0.05$). Slide layouts of the theoretical class presentations were the leading preference for anatomy study sources in Central Anatolia (54,8%) and Black Sea (60,2%) regions whereas atlases were the first choice in Aegean region (39.4%) and the differences were statistically significant ($p<0.05$). Regular repetitions were the leading study method preference in Southeast (27,4%), Central Anatolia (24,4%), Aegean (22,7%) and Marmara (20%) regions whereas correlation of structures with functions was the leading preference in Mediterranean region (21,3%) and correlation of structures with relations was the leading preference in Black Sea region (24,6%) and the differences were statistically significant ($p<0.05$).
Detailed interpretation of study preferences may lead changes in anatomy curricula in the future.

O051

Exploring the effectiveness of near-peer teaching in anatomy education compared to its application in other medical subjects

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The near peer teaching (NPT) programme is well-established and integrated within anatomy education at Southampton. The scholarly benefits have been reported on extensively by the current authors and by others in the field. While the NPT approach has often been described as being versatile and applicable to a number of subject areas, it is important to optimise its use in those areas of greatest need.
It has been reported that the benefits of NPT are most significant when the subject matter is difficult and seldom grasped by students at the time of first exposure. Immunology is one such subject, and as such, the aim of this study was to compare the NPT experience between these subjects.
During the 2017/18 academic year (n = 16) NPT's were trained to deliver small group teaching sessions in both anatomy (cranial nerves) and immunology (multiple sclerosis) to BMBS year 2 students at the University of Southampton. The format of teaching was matched as closely as possible and students were unaware of the purpose of the investigation. A ten item survey was used to compare the student learning experience, while pre and post tests were implemented to measure knowledge gain.
Results indicate that the student experience was rated higher across all ten criteria in the immunology setting, most notably in developing a rapport between teacher and learner. As expected, student's knowledge improved significantly in both groups - normalised gain 0.01

and 0.03 for immunology and anatomy respectfully.
Although this study clearly has limitations in terms of its comparability, it demonstrates that despite the long standing application of NPT in anatomy education, it can strongly benefit other subjects and may have an even greater impact on the student experience than in anatomy.
This study was approved by the Faculty of Medicine Ethics Committee.

O052

Challenging subjects in medical education: how effective are educational videos?

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A requisite of modern medical curriculums is self-directed learning, facilitated by online multimedia resources. This study aimed to assess the impact of different educational video formats versus traditional teaching techniques in the challenging subjects of histology and pain physiology.
A randomised, cross-sectional study was conducted with 136 medical students enrolled at the University of Southampton. 60 fourth- and fifth-year students assessed the histology resources, and 76 second 2nd year students assessed the pain histology resources.
Participants were randomly assigned to a text-based resource, interactive video, or screencast group. Outcomes measured were:
Knowledge gain and retention assessed using OBA-style MCQ tests
Student perceptions using 1-10 Likert-scale questionnaires.
A significant improvement in mean normalised knowledge gain was observed for all teaching modalities. For pain physiology, the mean normalised learning gains were: Text - 49.0% (n=23), interactive video - 70.1% (n=26), and screencast - 53.8% (n=27). For all learning gains, P<0.001. For histology, the mean normalised learning gain was: text - 76.7% (n=20), interactive video - 74.4% (n=20), and screencast - 61.1% (n=20). For all learning gains, P<0.001.
For pain physiology, interactive video significantly improved learning gain in comparison to the interactive video and the text resource (p<0.005). There was no significant difference between the learning gains of those who used the text or screencast resources.
Following teaching, 80% of students considered integrating videos into their learning. They felt that animations, clear layout and even humour are important to ensure engagement with educational video.
This study is the first to assess the impact of different educational video modalities for histology and pain physiology. The integration of these tailored videos provide an additional resource for students to enable challenging subjects to become more engaging.
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O053

Are we getting a head start in developing sound clinical acumen? Medical students' perspectives on reduced neuroanatomy, and head and neck anatomy contact teaching hours

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Undergraduate anatomy teaching hours are rapidly decreasing worldwide; the student voice is rarely considered in curricular decisions that invariably impact greatly upon future career decisions, and development of clinical acumen.

The Royal College of Surgeons (RCS) estimated circa 150 hours (mean) of anatomy teaching is being delivered across UK medical institutions, nearly a third of these in the dissecting room. A UK-wide core anatomy syllabus for medicine found the highest perceived deficiencies in head and neck anatomy, despite this region being considered among the most essential anatomical knowledge. We scrutinised the anatomy outcomes of one institution (a limitation, but future research will expand upon data from this institution) against national guidance, and subsequent clinical application of anatomy knowledge acquired in the early years. Anatomical Society learning outcomes were analysed and compared against institutional outcomes. These were examined in the context of reflective experiences of fourth-year medical students on neurosurgical/neuroanaesthetics placements, and mapped against relevant learning outcomes. Contact hours in regional anatomy displayed a dramatic decrease to two-thirds of the RCS estimation and, more recently, to less than a third. We discovered gaps in implementing surgically-relevant anatomical knowledge. Clinically-relevant anatomy around key procedures, such as intubation, arterial blood gases, chest drains, catheterisation, IV access in general and clinical examination, was largely absent in the clinical years. Despite some anatomy teaching on some regions, without practical application reinforcing the underlying anatomy students felt unprepared to carry out procedures. Reductions in anatomy teaching have far-reaching consequences for surgical training applications and, critically, on the ability of recently-qualified doctors to perform clinical procedures. As anatomy is the cornerstone of sound clinical acumen, we recommend applying a vertically-integrated approach where anatomy and clinical practice are closely interwoven, and anatomical concepts revisited regularly within context to solidify knowledge.

No ethical approval was required for this project.

O054

Differences in attitudes towards learning neuroanatomy between typical medical students and those attending the National Neuroanatomy Competition

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Neurophobia is an increasingly documented deterrent amongst medical students and doctors. However there remain medical students who show an affinity for neuroscience and wish to pursue neuroscience-related medical careers. The characteristics that lead to this dichotomy is unclear. The aim of this study was to identify the differences in attitudes toward learning neuroanatomy between a standard cohort of medical students, and a self-selected cohort of neurophiles attending the National Undergraduate Neuroanatomy Competition (NUNC).

The 30-item Glynn Science Motivation Questionnaire was modified for neuroanatomy and distributed to second year medical students at the University of Southampton and competitors at NUNC during the academic years 2017/18 and 2018/19. The cohorts were compared in each questionnaire item using Cohen's D test for effect size. 378 responses were received from University of Southampton students (standard medical students group) and 200 responses were received from medical students attending the NUNC (neurophiles group). Twenty-five items were significantly different between the two groups however only 11 had a Cohen's D >0.50. These 11 items questioned themes of personal enjoyment of neuroanatomy, future career motivation and examination anxiety. Items surrounding self-determination, self-belief in neuroanatomy ability and motivation towards high grades, whilst still significantly different in favour of the NUNC students, had a Cohen's D <0.50.

Identifying areas where attitudes towards learning neuroanatomy differ can form the basis for future educational initiatives to make neuroanatomy more accessible for all medical students. By overcoming these psychological barriers early in medical school it may be possible to reduce neurophobia amongst practising doctors. Further investigation should be targeted towards these specific attitudes and their underlying causes.
This study was approved by the University of Southampton , Faculty of Medicine Ethics committee.

O056

3D printing scaffolds for tissue engineering the knee mensicus: evaluating the biocompatibility and mechanical properties of different polymers

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The knee menisci are crescent shaped, fibrocartilage discs found in the knee joint. It has a unique composition of 70% water and 30% organic matter (such as collagen), which allows for its load bearing properties. Current methods for meniscal repair lead to future complications, and so novel approaches using biomaterials to tissue engineer a meniscus are being developed. In this study, four different polymers (Polylactic Acid (PLA), Thermoplastic Polyurethane (TPU), Copolyester Elastomer (nGen) and a Polyether-Polyurethane (Filaflex)) were evaluated through cellular, mechanical and characterisation tests, with a focus placed on improving their biocompatibility through the addition of alginate. Scaffolds made from the polymer-only, and an alginate-polymer composite were created, and human articular chondrocytes were seeded on both types of scaffolds. Biocompatibility was tested using AlamarBlue® cell proliferation assay and a Live/Dead® cell viability assay, which showed that none the polymers were cytotoxic and all supported cell growth, with PLA being the most beneficial to cell proliferation. The addition of alginate was showed to have detrimental effect to cell proliferation, but a positive effect in cell viability and cell morphology. Mechanical properties (tensile strength), along with characterisation of the polymers through Fourier-transform infrared spectroscopy (FTIR) and water uptake tests were carried out. These tests, combined with the biocompatibility studies, showed that although PLA had the best biocompatibility, its characteristics and mechanical properties did not match that of the native meniscus. Filaflex had similar characteristics to a native meniscus in terms of water absorption but had poor biocompatibility. Though the results are promising in that each material had its own strengths, further research into different polymer combinations should be carried out to find a balance into creating a scaffold with good biocompatibility and mechanical characteristics.
No ethical approval was required at this stage.

O057

New Landmarks for the Open Approach of Carpal Tunnel Syndrome: A Human Cadaveric Study

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Carpal tunnel syndrome is the condition in which there is a trapping of the median nerve in its passage through the carpal tunnel. The classic treatment is the decompression by section of the transverse carpal ligament. The preferred approach is the open release with minimum incision. This study arises from a technique used by an experienced surgeon (M. Londinsky), who proposes as a safe incision place, for the open approach, the central point of the superficial middle palmar space. To determine the proposed incision's safety, comparing it with the classic

one. And standardize a safe incision area, through new anatomical landmarks. 10 upper limbs of adult cadavers were used. Hydrodissection of the superficial middle palmar space with serum was performed. A minimal incision was made at its midpoint, vertical and perpendicular to the palm. Nerve and muscle injuries were assessed. The proposed incision was compared with the classic landmarks. The presence of superficial middle palmar space was evidenced. The topography of the midpoint in relation to the anatomical landmarks used for the classic incision was variable, due to the variability of the dimensions of this space between each individual. The safety of the proposed incision was tested, directly accessing to the transverse carpal ligament for it's opening, without evidence of nerve injury. A new incision is proposed for the open approach of the carpal tunnel syndrome, using the midpoint of the superficial middle palmar space as anatomical landmark. Its main advantage over the classic incision is that it adapts to the anatomy of each patient, respecting the existing inter-individual variability. Human Anatomy's Department of Medicine School (Facultad de Medicina - Universidad de la República), has an informed consent form for the donation of bodies for academic proposes.

O058

Anatomical study of the right retro-portal lamina

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The right retro-portal lamina (RRPL) was first described by Prionton and Laux in 1959. Its description is not very detailed, and it does not appear in classic anatomical texts. Its situation, in continuity with the pancreatic uncus, exposes it to loco-regional invasion in case of pancreatic head cancer. It is of interest to the surgeon at the time of its resection in order to reduce the percentage of local recurrence, and improve patients survival.

An anatomical and histological study of the RRPL, in view of its surgical management with the maximum possible safety.

A descriptive anatomical study of 30 adult cadavers, fixed in solution based on formaldehyde was made. Informed consent is condition for the body donation for academic purposes in the Department of Anatomy. The presence of the lamina, its insertions, dimensions and macro and microscopic content was registered.

RRPL was found in 100% of the cases. It took insertion on pancreatic uncus and on the vascular sheath of the superior mesenteric artery (SMA). Its dimensions vary to an average of 20 mm length, 17 mm width and 3 mm thickness. The inferior pancreatic-duodenal artery was identified in 25% of the cases. Pancreatic and adipose tissue, as well as vascular and nervous elements were identified.

The RRPL is remnant of the pancreas primitive mesodorsal. It can be identified with relative ease given its constant insertions, its disinsertion of the SMA requires a sub-adventitial dissection. Its dimensions vary according to the series. The content was concordant with the bibliography consulted.

The RRPL is a constant connective-vasculo-nervous formation. It presents precise limits. It contains vascular and nervous elements, which argue in favor of its resection in order to avoid local recurrences at this level.

O059

Bean-shaped kidneys or kidney-shaped beans? - On geometrical analysis of the renal shape

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Despite similar functions and development in metanephric kidneys of higher animals, renal anatomy is known to demonstrate considerable

inter-species variations including its shape. This presentation will provide a robust mathematical/physical understanding of renal anatomy with comparative studies based on the hypothesis that the characteristic bean-shape of kidneys is not merely an accidental observation; but, a result of sophisticated engineering by nature enabling the kidneys to cope with the enormous blood flow and continuing filtration despite considerable mobility observed in animals (e.g., dog, cheetah). This presentation will reveal some intriguing mathematical/physical concepts starting with the known bean-shape while slowly unfolding into the realms of comparative anatomy (e.g., unfused bovine kidney, multilobular avian kidneys, one heart-shaped & another more bean-shaped kidneys in horse).

An apt term to describe the bean-shape of kidneys is "nephroid" when observed antero-posteriorly. In Cartesian geometry, such a bicuspid epicycloid nephroid is produced by rolling a smaller circle of radius "a" on a bigger circle of radius "2a". The locus of such a function assuming the origin (0,0) at the center of the larger circle is:

〖(x^2+y^2-〖4a〗^2)〗^3=108a^4 y^2

Interestingly, the ensemble renal structures can be mathematically modeled while placing the origin (0,0) on the aorta midway between the two renal hila and drawing a nephroid structure with x- and y-coordinates directed at right angle (i.e. transversely). Interestingly, "Cassinian oval" – another Cartesian shape can explain the anatomy of the kidneys viewed superiorly. The locus of the shape, assuming origin (0,0) on aorta while transverse and sagittal planes denoting x- and y-coordinates, respectively is:

〖(x^2+y^2)〗^2-〖2a〗^2 (x^2-y^2)-a^4+c^4=0

[c=distance of the two foci from origin; a=product of the distances of a point from the two foci]

This talk will establish the foundations of renal anatomy on robust physical/mathematical principles with further implications towards explaining anatomy of other organs, such as, heart.

O060

2D browsing software and 3D models of real colour sectioned images of rhesus monkey

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Rhesus monkeys have great research potential because of their similarity to humans. To properly research Rhesus monkeys, veterinarians and primate researchers should understand monkey anatomy and radiology. With three-dimensional (3D) models and browsing software for cross sectional anatomy, the anatomy and radiology of monkey can be learned accurately and easily. The objective of this study was to provide accessible and instructive browsing software and 3D models that included true color sectioned images and 3D models of an entire monkey.

To achieve this purpose, the sectioned images of a whole monkey body, made in previous study, were used (IRB number, KRIBB-AEC-18087). In the sectioned images, thirty structures (skin, skull, cerebrum (gray matter, white matter), cerebellum, spinal cord, dura mater, cerebrospinal fluid, muscles of the head, sclera, cornea, vitreous humor, lens cortex, lens nucleus, tongue, trachea, esophagus, thyroid, heart, lung, stomach, liver, gall bladder, bile duct, spleen, kidney, small intestine, large intestine, urinary bladder, uterus) were segmented semiautomatically using Adobe Photoshop to produce segmented images. The sectioned and segmented images were then packaged into browsing software which the images can be displayed continuously with their names in real time. After the segmented images were reconstructed by surface modelling on Maya software to make 3D models (STL format), the 3D models were exported into a PDF file which enables users to manipulate 3D models freely. The browsing software and PDF file will be helpful for the students and researchers to learn monkey anatomy and radiology.

O061

Prionace glauca (blue shark) seriated CT-scan and reconstructions: horizontal, sagittal and 3D

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The pole shark (Prionace glauca) is a large, common, pelagian condrichtyan. The aim of the study was to detail by CT-scan, the internal, anatomical structures of the head of a shark on thin, joined cross-sections and to show their relationships. The prionace glauca was chosen as it was the largest shark which could be freely fished off Brittany's coast and it was therefore easy to obtain the tissue required. The authors had previously scanned this species. Material The entire, rostral extremity (28,4 cm long) of an adult specimen was CT-scanned along the rostro-caudal axis, in axial cross-section and reconstructed. The CT-scan apparatus was a Siemens somatom, whole body, apparatus with 64 detectors. Methods The frozen shark's head was laid in a prone position on the radiological table and was CT-scanned. Three hundred fifty-five frontal cross-sections were obtained from the native acquisition (100 kV, 18 mAs) in the axial plane: the cross-sections (every 0,8 mm, 1mm thick) were joined. Two different penetrations were used: B30 for the soft parts and B70 for the hard parts (cartilaginous skeleton). Results One hundred para-sagittal and one hundred horizontal cross-sections were reconstructed. Sixteen 3D reconstructions were realised with several incidences and penetrations. Conclusion The muscular masses presented little differentiation. The cartilaginous structures were well visualised, as were the eye and the central nervous system. The teeth were particularly clear on the reconstruction, especially the successive rows in the lower jaw.

O062

Age-related changes in the testicular capsule and peritubular boundary tissue of the Japanese quail (Coturnix coturnix japonica)

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Myoid cells in the testicular capsule and peritubular boundary tissue aid the movement of spermatozoa from the seminiferous tubules to the excurrent ducts. There is a paucity of information on age-related changes occurring in testicular myoid cells in birds. The aim of the present study was to investigate changes in the testicular capsule and peritubular boundary tissue of pre-pubertal (4 weeks old), pubertal (6 weeks old), adult (12 weeks old) and aged (52 weeks old) Japanese quails. A total of 28 Japanese quails were sacrificed by decapitation following manual stunning. The procedure was approved by the University of Pretoria's Animal Ethics Committee (approval number V034-18). Tissue samples were processed routinely for immunohistochemistry and transmission electron microscopy. Cytoskeletal proteins (vimentin, smooth muscle actin, desmin), and basement membrane components (collagen type IV, fibronectin, laminin) were demonstrated using immunohistochemistry. In the current study, smooth muscle actin and desmin were demonstrated in myoid cells of the testicular capsule and peritubular boundary tissue. The immunoexpression of smooth muscle actin and desmin decreased as the birds aged. Fibroblasts in the testicular capsule and peritubular boundary tissue were vimentin immunopositive. In addition, myoid cells in the peritubular boundary tissue exhibited vimentin immunoreactivity. Ultrastructurally, myoid cells in the testicular capsule were characterized by the presence of cytofilaments and cytoplasmic plaques, which increased in density with age. Myoid cells in the peritubular boundary tissue contained cytofilaments and abundant rough endoplasmic reticulum cisternae. The intensities of the

basement membrane markers, collagen type IV, fibronectin and laminin, increased with age. In conclusion, the study has shown that myoid cells in the peritubular boundary tissue are myofibroblastic in nature. The information gained from this study will provide a morphological baseline for further studies on the effects of environmental toxins on the elements forming the testicular capsule and peritubular boundary tissue of birds.

O063

Junctional complexes of the blood-testis barrier in the Japanese quail (Coturnix coturnix japonica).

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The localization and distribution of proteins forming the junctional complexes of the blood-testis barrier in mammals and reptiles have been well-documented. However, relatively little is known about the proteins forming the blood-testis barrier of birds. The aim of the current study was to investigate developmental changes in the gap junctions, tight junctions, and adherens junctions forming the blood-testis barrier in the Japanese quail. Pre-pubertal (4 weeks old), pubertal (6 weeks old), adult (12 weeks old), and aged (52 weeks old) quails were sacrificed by decapitation. All experimental procedures were approved by the University of Pretoria Animal Ethics Committee (Approval number V034-18). Testicular tissue samples were collected and processed routinely for immunohistochemistry, western blot and transmission electron microscopy. The immunohistochemical and western blot studies utilized primary antibodies against connexin 43 (CX43), zonula occludens 1 (ZO-1), claudin 3, claudin 11, occludin, N-cadherin, E-cadherin and β-catenin. The results of the study showed that the tight junction proteins, ZO-1, occludin, claudin 3 and claudin 11, were localized in the plasma membranes of adjacent Sertoli cells, as well as between Sertoli cells and spermatogonia in all age groups studied. The adherens junction proteins, N-cadherin, E-cadherin and β-catenin, had a similar distribution pattern. The gap junction protein CX43 was localized only between Leydig cells in the testicular interstitium. However, TEM revealed the presence of gap junctions between cells of the seminiferous epithelium as early as the pre-pubertal stage. Furthermore, TEM confirmed the presence of well-developed tight and adherens junctions in the seminiferous epithelia of all age groups. The findings of the study indicate that the junctional complexes forming the blood-testis barrier in the Japanese quail are well established prior to puberty.

O064

Lumbosacral biometrics and its usefulness in predicting lumbosacral conditions in some canine breeds.

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Lumbosacral conditions are commonly encountered in canine practice. Despite their prevalence, there is a lack of breed-specific biometric data available. This work is an extension of a previous radiographic and dissection study, which looked at the variation in lumbosacral anatomy (Lumbar vertebra 7 and the fused Sacrum) of 109 dogs across four breed categories (Working Breeds, Large Breeds, Giant Breeds, Cross Breeds). ImageJ Software (NIH) was used to measure the height, length and area of lumbar vertebra 7 and the sacrum, measured as a composite of three vertebrae (S1-S3). Two lumbosacral biometric parameters were created: Area-Mean ratio (AMR) and Height-Length ratio (HLR). Differences in age, breed and sex within the breeds were normalised using the ratio-metric approach during the data analysis. This study aimed to investigate a possible causal relationship between each parameter and the presence of lumbosacral problems. The original caseload (n = 109) was modified to include only

dogs diagnosed as having a lumbosacral condition (n = 105), as assessed by an experienced radiographer. The data were analysed and used to calculate the AMR and HLR of both bones for each of the 105 dogs. Diagnoses were arranged into seven main categories: Fractures (7); Hip Dysplasia & No secondary changes (8); Hip Dysplasia & Secondary changes (39); Lumbosacral Stenosis/Spondylosis (9); Lumbosacral & Pelvic Diseases (12); Others (14); No Appreciable Disease (16). Each biometric parameter was plotted against one of the seven categories to determine if a possible trend existed.
A larger sample size and the incorporation of more breeds would better determine the accuracy of using lumbosacral biometrics as a tool to predicting the occurrence of lumbosacral conditions. A further study where demographics are taken into account would be useful as well. The study was reviewed and approved by the UCD-Animal Research Ethics Committee (Approval number: AREC-E-19-05-Kilroy).

O066

Reduction of formaldehyde exposure in anatomical theatres

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Formaldehyde has been classified in the European Union as a carcinogen. The health-based Occupational Exposure Limit (OEL) value legally binding in Germany for formaldehyde is 0.37 mg/m³ (0.3 ppm). This OEL must be observed at workplaces in anatomical institutes in German universities.
Measurements have revealed that the OEL for formaldehyde is often exceeded not only during embalming of human specimens but also in practical anatomy courses. Concentrations of up to 13 ppm have been recorded. Since at present only limited means exist for substituting formaldehyde in the applications referred to above, technical and organisational arrangements must be made. Research conducted nationwide has shown that measures for capturing volatile substances at the point of origin by suctioning the dissecting tables are for the most part not in place, and the ventilation and air-conditioning measures applied do not function adequately.
A multistage research project was therefore conducted jointly by German Social Accident Insurance Institutions for the public sector and the Institute for Occupational Safety and Health (IFA). Within this frame, the efficiencies of various existing ventilation systems were compared under reproducible boundary conditions. A simulation model was developed and verified by test bench experiments. An estimation of the formaldehyde concentration via simulation calculations was followed by an examination of the efficacy of an optimised preparation table under standardised test conditions. Finally, the concept was checked in an authentic anatomical theatre.
It was shown that under real conditions, a subtly balanced system, combining decisive parameters including preparation table design, room temperature and ventilation characteristics in an appropriate manner, results in a significant reduction in the formaldehyde concentration in anatomical theatres to below 0.1 ppm.
(No ethical approval required.)

O067

Contention or Coping? Shining a Light on Dark Humour in Anatomy Labs

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Anatomy labs can be psychologically demanding, and present unique proximity to death. Yet, it is not well understood how individuals cope with anatomy lab-related stressors. In acutely stressful medical settings, a documented coping mechanism is dark, or black, humour. This study aimed to understand if dark humour is also used in anatomy labs, and if so, how and why it may be used.

In this Hull York Medical School, Ethics Committee approved-study, an electronic survey was designed including demographic, frequency rating, and free-text questions. The study was open internationally, and participants with anatomy-lab experiences were recruited via social media and virtual snowball sampling. Descriptive analysis was performed on demographic information, and open-ended questions were coded via an inductive approach to identify major themes.

A total of 185 participants completed the study, representing 9 countries. A variety of anatomy experiences were reported, including 31% of participants who identified as anatomy academic staff, and 33% health care programme students. The vast majority of respondents (72%) acknowledged hearing and/or using dark humour in anatomy labs. Humour was frequently regarded as a coping mechanism for the 'morbid' work of anatomy labs. When considering use of humour, many commented on internal 'barometers' such as audience, personality, and personification of donors, used to gauge if comments were 'appropriate.' A minority of participants believed humour overall was 'inappropriate,' and use of humour demonstrated disrespect towards donors.

These findings indicate that dark humour is frequently being utilised in anatomy labs, but there is a stark polarity between some who view humour as never 'appropriate,' and those who believe it normal/necessary. Such opposition highlights the need for further research. and open discussions about professionalism and ethics within the anatomy education community.

O068

How scientific research could help shaping body donation practice in Turkey?

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Body donation is infrequent in Turkey. Although literature provides empiric evidence on donor behavior and institutional practices, effects of regional and cultural differences are significant. In order to define the reasons behind low donation rates and promote body donation, a series of research studies were carried out since 2014. First, a sectional study for outlining current cadaver sources in anatomy departments was performed. Secondly, profiles and motivations of registered body donors were investigated between 2014 and 2017. Similarly, a retrospective seasonal analysis was done to see annual changes in donation registrations. Finally, student oriented studies on donor anonymity and educational interventions were conducted. Results showed that body donations were limited to cities with higher economic and educational levels. There were two donor groups with different educational levels, marital statuses, and religious choices. Motivational themes of impermanence and religion were prominent while a newly identified motivation of awareness was present. New targets for awareness campaigns such as blood and organ donation units were identified. Monthly registration rates increased in April, May, June, October, and December. The donors were willing to share their medical and personal information while medical students were ready and willing to receive the former yet objected the latter. According to these data; registration forms were revised, public awareness activities were focused to limited months, memorial services have been implemented, and didactic and interactive lectures were incorporated for increasing the awareness of medical students. Additionally, ongoing studies on memorial services, willingness among healthcare professionals, and nationwide registration rates are being planned and conducted. Departmental and multicenter research studies have helped us to collect evidence on regional population and culture that changed anatomy practice at our institution within five years. Similar studies with wider collaboration may have the potential to shape nationwide practice for all medical faculties.

O069

Cadaver procurement at the University of KwaZulu Natal:

trends of the past and recommendations for the future

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The public image of anatomy at Higher Education Institutions (HEIs) in South Africa reflects the use of gross, microscopic and anthropological anatomy, which involves the use of human remains (i.e. cadaveric and skeletal material) for teaching and research. This has been shrouded by ethical dilemmas as the method of procurement of cadavers has been described as controversial. In 2004, the Department of Clinical Anatomy (DOCA) at the University of KwaZulu Natal (UKZN) was formed by the merger of the departments of anatomy at the University of Durban Westville and University of Natal Medical School. The aim of this study was to document the trends in cadaver procurement and make recommendation for the future. Data was collected and analysed from cadaver records were obtained from DOCA (Ethical Clearance was obtained BE 524/14 from the Biomedical Research Ethics Committee at UKZN). At UKZN, the trend of procurement of cadavers has transformed over the political eras from reliance on paupers, prisoners and unclaimed indigent persons (ie. bodies of Black African who suffered racial prejudice and discrimination during apartheid) to body donation. At one stage, the use of unclaimed bodies were seen as the norm, documented as donations from inspectors of anatomy, legally obtained but unethical in its practice. This study highlights the need for consultation with appropriate stakeholder groups (including indigenous) and a protocol for cadaver procurement at UKZN.

O070

Dissecting the anatomy of late-medieval and early-modern English carved cadavers

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We will examine the pre-Versalian history of anatomical knowledge in England through an examination of late-medieval and early-modern carved cadavers. Carved cadavers in England date from the early 1400s and were a particular genre of mortuary art particular to wealthy landowners, prosperous merchants, and high-ranking clerics. Intimately connected to Roman Catholic death and afterlife beliefs, they imaged a specific individual naked, and emaciated. Highly symbolic, a few prominent recusant (Roman Catholic) individuals continued to be memorialised with a carved cadaver even once England became a Protestant country.

As well as providing a theological window into this period of history, these sculptures shed light on the currently under-researched topic of pre-Versalian anatomical knowledge in England. By comparing and contrasting a selection of carved cadavers, we will present evidence which demonstrates that some of the sculptors had a reasonably good knowledge of surface anatomy, enabling them to sculpt an emaciated cadaver to a very high level of accuracy; perhaps somewhat surprisingly, the earlier carved cadavers often have a higher level of anatomical accuracy than the later ones, and a representative sample across the genre will demonstrate this.

A small number of carved cadavers in England however, go beyond surface anatomy and show internal anatomical structures; one particular example is a sculpted eviscerated torso, whilst another depicts the contents of the abdomen in situ. We will contrast and compare both sculptures to exemplify the level of anatomical knowledge of the sculptor, but also will draw on contemporary illustrations of the body to demonstrate how these carved cadavers shed light on a largely hidden history of anatomical knowledge in pre-Versalian England.

The University of Winchester's Ethics Committee has given Dr Christina Welch ethical approval for historical work on carved cadaver sculptures; there are no ethical implications to this study.

O071

Supernumerary bones of the human elbow

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The aim of the study was to state the incidence of the supernumerary (accessory and sesamoid) bones of the elbow region in the Middle European population. The supernumerary bones around the elbow are rare variants with non-assessed nomenclature and incidence based on little amount of studies and potential confusion with pathological structures can easily happen.
2000 X-ray in two planes were evaluated, the findings were distributed based on the position related to the elbow joint and pathological structures were excluded (based on their shape and position). The results were processed using Kendall rank correlation coefficient and logistic regression for a sanity and new terms were proposed for some of the bones. The study was approved by the Institutional Review Board.
The frequency of the elbow supernumerary bones was 0.88%, The most commonly present bone was situated distally to the medial epicondyle of the humerus in 0.46% (medial subepicondylar bones), the second most commonly observed was found laterally to the lateral epicondyle of the humerus in 0.21% (lateral subepicondylar bones) and the third most commonly present was registered in front of the trochlea of the humerus in 0.10% (brachial sesamoid bone), followed with the posterior supratrochlear bone and the tricipital sesamoid bone, both present in 0.05% of cases. The anterior supratrochlear bone have not been recorded at all.
The knowledge about location, shape and incidence of the supernumerary bones of the elbow could help in during diagnostics of avulsion fractures and other pathological states involving the elbow joint and region.

O072

Anatomy teaching with DICOM image viewer on iPad as an adjunct to medical students

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Medical students in their clinical training and subsequent practice will apply their anatomy knowledge in medical imaging. Junior doctors and medical students have criticised the lack of radiology anatomy teaching in undergraduate years, leading to future uncertainty whilst on the ward and unable to interpret images, especially CT or MRI. Anatomy teaching via DICOM viewer(OsiriX) on iPads helps students to appreciate more arbitrary planes. The study aimed to implement and investigate the role of DICOM viewer(OSIRIX) on iPad as an adjunct to anatomy teaching. Eighty-five first year medical students at Durham University were included. Students initially identified anatomical structures on a CT scan of the chest during pre-test using a questionnaire. Each group of students used two iPads (four-six students/iPad) and viewed CT scan images in different planes using OsiriX for about twenty minutes facilitated by a tutor. A post-test was conducted. Feedback was obtained at the end of the session. Data was analysed using paired t-test. Qualitative data from the free text comments was analysed using thematic analysis. A significant increase in knowledge scores was observed in the post-test when compared to the pre-test($p<0.001$). Majority felt that the session was useful(73/85:86%), improved their ability to recognise anatomical structures on CT scans(74/85:87%), viewing images in different planes improved their anatomical knowledge(63/85:74%) and enjoyable(73/85:86%). Some of the themes that emerged from their feedback were application and consolidation of knowledge, clinical contextualisation, identified knowledge gaps, helped in focussing revision, improved recognition of structures and their relationships, improved confidence, team work and interactive

session. The study demonstrated a significant improvement in students' ability to recognise anatomical structures on CT scans with positive feedback. DICOM viewer can be a useful adjunct to teach anatomy in a clinical context helping students to interpret clinical images whilst being cost-effective. Ethical approval was obtained from Durham University(ESC1/2016/01).

O073

Vertebral body volume and lumbar spine pathologies in modern human population

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Low back pain (LBP) has been associated with anatomical variations in vertebrae size and shape. This study examines the association between lumbar vertebral body volume (VBV) and vertebral pathologies associated with LBP. Designed as a retrospective cross-sectional study, it was carried out on adults who had undergone CT scans prior to the study.The use of CT images was approved by Helsinki Committee of the Carmel Medical centre (Helsinki protocol 0057-11-CMC). Images were obtained from Philips scans (Philips Brilliance 64). The studied sample consisted of 210 individuals (105 females and 105 males) with an age range of 18-91 years. The VBV for all lumbar vertebrae was calculated as the mean vertebral body heights [(anterior + posterior)/2] multiplied by the mean discal surface areas [(superior + inferior)/2]. Three types of pathologies were recorded: osteophytes, Schmorl's nodes (SNs), and vacuum phenomenon (VP). Lumbar VBVs were significantly greater in males than in females at all levels ($p<0.01$). In males, significant positive correlations were found between VBV and age at all lumber levels (except L4), whereas in females, only a VBV of L5 manifested a significant correlation with age ($r=0.240$, $p<0.01$). In males, the means of VBV in the SN group and the non-SN group were similar at all lumbar levels, except for L2 ($p<0.003$). In females, the means of VBV in the SN group were significantly greater than in the non-SN group ($p<0.004$) in all lumbar vertebrae. In males, the means of VBV in the osteophyte group were significantly greater than in the non-osteophyte group at all lumbar levels, except L1. Among females, significant differences in mean VBV between the osteophyte and non-osteophyte groups were found only for L1 and L5 ($p<0.05$). In both sexes, no associations were found between VBV and VP. VBV is positively associated with the occurrence of SNs and osteophytes.

O076

Clinico-developmental Spectrum of Human Neural Tube Defects and its Genetic Correlation

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Neural Tube Defects (NTDs) affect over 300000 births globally every year and constitute one of the most common preventable congenital anomalies. NTDs are basically classified as cranial and spinal dysraphisms in addition to open and closed types. The various types of NTDs ranges from subclinical spinal bifida occulta (10 % of population) to most severe forms of NTDs like anencephaly(1/ 1000 births).

Despite intensive clinical and experimental research, the etiopathogenesis of NTDs is poorly understood but involves maternal genetic predisposition with environmental influence leading to disruption of numerous molecular regulations during the process of neural tube development. The present study was done in Anatomy Department of JIPMER, Puducherry, South India in collaboration with departments of Neonatology, Obstetrics and Gynaecology and Biochemistry. I came across different forms of NTDs viz; anencephaly, enephalocoele, meningo-encephalocele, meningocele – cervical, thoracic, lumbar, lumbosacral and spinal bifida occulta after obtaining ethical approval.

The aim of the study was to study the frequency and association of maternal genetic polymorphisms in NTDs among cases and control groups in South Indian population.

Two groups were studied (cases and controls),with a sample size of 36 and 72 respectively. After obtaining written and informed consent, a brief antenatal history was taken as per the data proforma. The frequency of mutant and wild type SNPs of MTHFR gene, its association with NTDs were documented in both study and control groups.

The Data were analysed with GraphPad Instat software. Chi-square tests were used for the assessment of genotype frequency association between cases and controls. Fischer exact test with the approximation of Woolf, was done to find out the association and the odds ratio of homozygous variant in comparison with the other mutant genotypes.

To conclude, the frequency of mutant maternal MTHFR gene in particular C677T (rs18011133) was higher in cases compared to controls and the association was statistically significant. Further studies could titrate folate dose for prevention of genetically susceptible NTDs.

O077

The Anatomical Society Core Embryology Syllabus for undergraduate medicine

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This study describes the Anatomical Society's core embryology syllabus for undergraduate medical students. This has been constructed to aid educators composing and implementing their curricula, and also to aid students in their learning, providing clear expectations. While embryology is typically associated with obstetrics and paediatrics, developmental anatomy and teratology have relevance in multiple additional specialities. Following ethical approval from both RCSI and HYMS Ethics Committees, a Delphi panel was formed by recruiting relevant stakeholders, including anatomists, embryologists and clinicians, nominated by the Council and Education Committee of the Anatomical Society, resulting in a list of 44 potential panellists. Prior to commencing this study, no previously published embryology syllabi composed of learning outcome statements were available, thus this process began with a tabula rasa, developing an a priori set of learning outcome statements drawn primarily from syllabi of the co-authors' institutions. These learning outcome statements were then put to our expert panel in two stages, asking them to "accept", "reject or "modify (first stage only) each learning outcome. Sixty-two learning outcome statements were presented to the expert panel for the first Delphi Round. All sixty-two learning outcomes were re-circulated for Delphi Round Two, sixteen having been modified following comments and feedback from Round One. Overall, sixty-one learning outcomes achieved over 80% consensus and were included within the final core syllabus, while one was removed. The Delphi process, with consultation across diverse stakeholder groups, provides methodological rigor and facilitates development of a syllabus striking a balance, being both inclusive of necessary core content, while retaining flexibility to be applicable across varied educational contexts and institutions. This syllabus developed by the Anatomical Society recommends a core level of knowledge of embryological processes and presentations essential to all newly-qualified doctors, regardless of their subsequent chosen specialty, for inclusion within undergraduate medical curricula.

O079

Development of the sphenoid bone after birth

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The sphenoid bone forms the central part of the skull base and major part of orbital cavity boundaries. The aim of our research was to investigate the dynamics of postnatal development of the sphenoid bone. In our research, we measured 112 sphenoid bones (age range 0-30 years) from the collection of separated skull bones at the Institute of anatomy „Drago Perović“. We selected 11 parameters which indicated the development of different parts of the sphenoid and which were measured using digital caliper. For all observed parameters we calculated growth index (GI; average value at adult age /average value at birth), as well as total increase in size. The largest total increase was observed in the sphenoid bone width (52,7 mm). All parameters which indicated the development of the bone in width had a similar growth index which ranged between 1,6 and 1,7, except the width of sphenoid body which showed higher relative increase (GI 2,5; total increase 18,1 mm). The medial plate of pterygoid process increased more (23,2 mm; GI 3,4) than lateral plate (17,2 mm; GI 2,3) and also had the highest growth index on sphenoid bone. Orbital surface of greater wings of sphenoid increased significantly more vertically (16,2 mm; GI 2,9) than horizontally (12,1 mm; GI 1,7). Development of the sphenoid bone is a complicated process which reflects complex anatomy of the bone. The highest absolute increase was in sphenoid bone width. However, relative increase in width was moderate compared to the relative increase of pterygoid process plates. Understanding the dynamics of sphenoid bone development is important in neurosurgery and forensic medicine.
Research was conducted in accordance with ethical standards and protocols of University of Zagreb, School of Medicine

O081

Human Donor Cadaver Model to Design and Confirm a Thoracotomy Procedure Technique For Emergency Physicians

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Emergency thoracotomy conducted in emergency departments(ED) have notoriously been associated with very poor outcomes. Most trauma experts agree the primary factors leading to very poor outcomes is due to timing of the decision to conduct a thoracotomy and procedural difficulty. To gain access to the heart, the conventional thoracotomy approach for ED physicians is a left anterolateral approach. The objective of this study was to provide a technique revealing critical anatomy which would enable a non-surgeons to conduct life-saving thoracotomy for cardiac tamponade and cross clamping descending thoracic aorta of male and females. Following practice of left anterolateral and bilateral anterolateral or clamshell approaches conducted on unembalmed, lightly and traditionally embalmed human cadavers (n=34), clamshell approach was chosen for ease of procedure (required tools, skill of tool use and degradation of technique), rapid efficient access, and working visibility. Required tools were scalpel and trauma scissors for single user with assistant or scalpel, trauma scissors and Fianchetto spreaders for single user conducting a clamshell thoracotomy technique. Entering and maintaining the 4th or 5th intercostal space resulted in consistent optimal exposure of thoracic structures for emergency physician skill sets. This technique allowed ideal anatomy exposure to conduct a vertical incision of the pericardial sac anterior to the phrenic nerve evacuating pericardial effusions and more easily enabled cross clamping of the descending thoracic aorta for non-surgeons while avoiding the oesaphagus. Procedure affords a satisfactory suture closing technique for ED physicians, avoiding higher infection rates associated with midline sternotomy procedures. In summary, clamshell technique is not sophisticated, easily and rapidly performed, provides optimal anatomy exposure, and can be closed satisfactorily. The technique

can be done as a single user with 3 tools or 2 tools with an assistant and be taught in anatomy labs prior to chest dissection. IRB approval granted for cadaver research.

O082

Digital reconstruction of human mesenteric development: a novel embryological basis for multivisceral transplantation

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Embryological planes provide the basis for abdominal surgery. However, despite considerable surgical relevance, the development of the mesentery remains uncharacterized. This study aimed to generate three- and four-dimensional models of the mesentery in adults and during embryogenesis.
Ethical committees, both locally and at collaborating sites, approved the study before commencement. Embryological and foetal specimens (n=15; Carnegie stages 13 to week 10 post-fertilisation) were sectioned, stained and digitised. Manual tracing highlighted areas of regional anatomy. An internal panel of 2 reviewers verified manual tracings. Regression analysis (SIFT; ImageJ2, v1.50e, NIH, US) stacked sections in their true alignment. Advanced image analysis (Cinema4D; Maxon Computer GmbH, Germany) generated a four-dimensional, exploratory model of mesenteric and digestive system development.
By using advanced image analysis, mesenteric and digestive system development was animated in silico. Shape interpolation produced a spatiotemporal model of mesenteric development from 4 to 10 weeks. Computer-rendered reconstructions enabled direct visualisation of intestinal coiling, demonstrating that gut rotation does not occur. Three-dimensional reconstruction of fore-, mid- and hindgut regions of mesentery demonstrated that continuity between these regions persists into adulthood. Cadaveric dissection and comparison with foetal models confirmed developmental observations. Furthermore, cadaveric findings correlated with adult cross-sectional reconstructions from the visible human project dataset. Scanning electron microscopic analysis of the peritoneal reflection further characterised peritoneal microanatomy. A comparative anatomical study of mesenteric anatomy identified that mesenteric continuity from oesophagogastric junction to mesorectal level held across species.
These findings present a model of mesenteric development which differs considerably from classic descriptions. Persistence of continuity into adulthood provides a novel, anatomical route of disease spread. Additionally, it provides an anatomical basis for a novel approach to multivisceral transplantation. En bloc removal of the mesentery during cadaveric dissection confirms that the mesentery maintains all abdominal digestive organs in position and continuity with other systems.

O083

Case Based Discussion - an approach to integrate clinical anatomy teaching and learning.

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Undergraduate medical students are required to retain significant amounts of contextualized anatomy. They need to apply this to their patients. However, feedback suggests that students on the 5-year program can feel unprepared, transitioning from the classroom environment during the first two years to the hospital ward often struggling to link basic science with clinical practice. In an attempt to bridge science with the clinical environment Case

Based Discussions (CBD) was introduced to early learners.

Commonly used in the Foundation Training Programme by several Royal Colleges, CBD (alongside other workplace-based tools) can assess clinical judgement, decision making and applied medical knowledge. We adapted this as a tool for emphasizing clinical anatomy concepts for year 2 students, integrating content with other discipline groups.

Eight scenarios were developed which link to each systems-based topic within our Year 2 teaching programme. Eg An irritable child with fever and a rapid heart rate who later becomes drowsy and develops a rash. The case is meningitis, but short answer questions are wide ranging, simulating a clinical placement and includes reviewing the medical imaging, outlining the anatomy and coverings of the brain, likely aetiologies, applied anatomy & physiology of cerebrospinal fluid circulation and why nerve palsy is sometimes seen. Students work individually or in small group during the 30-minute facilitator led sessions.

Qualitative data collected using a 5-point-Likert-scale questionnaire after the first iteration (2017) captured responses with equal ratios of students (1/3) feeling that CBD had enhanced anatomy learning as those that did not. Key modifications were then re-evaluated (2018). Altering the mode of delivery, the presenter, clinical approach and scenarios re-written by junior doctors served to reduce the “top down” effect, linked back to prior learning and emphasised knowledge in practice while also recognizing the power and effectiveness of near peer teaching (NPT).

O084

Assessing the internal architecture of the immature human mandible during dental development

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During the transition from the prenatal to the postnatal stages of growth, the human mandible and the masticatory apparatus adapt to significant variations in biomechanical forces associated with the development, emergence and eruption of the dentition. Loading conditions acting on the mandible are thought to influence the modelling and remodelling of bone, with site-specific effects on the bone mineral density. The internal architectural features of the basal region of the mandible have been described in various animal models and are dependent on function. Hence these features may change in the human in relation to dental development and eruption. The aim of this study was thus to evaluate changes in bone mineral density and internal architectural features of trabecular bone across the body of the immature mandible during the early stages of dental development. Forty-five fetal and neonatal mandibles (30 gestational weeks to 5 years postnatal) sourced from the Johannesburg Forensic Paediatric Collection and the Raymond A. Dart Collection of Human Skeletons, School of Anatomical Sciences were subjected to micro-CT assessment using a Nikon XTH 225L micro-focus CT X-ray unit (scanning parameters were set to 100KV / 100µA and 100µm). Ethics approval for this study was obtained (Medical; M121145). Parameters investigated included: bone density, trabecular spacing, trabecular thickness and other volumetric data across all existing dental crypts. Univariate and multivariate statistical analyses were undertaken. Changes across all parameters were consistent with the relative stage of dental development when comparing the late prenatal and early postnatal periods of growth. Significant decreases in volumetric variables were observed between 1 and 4 years of postnatal growth. The internal architecture of the basal region of the mandible appears to adapt to accommodate the development and functional demands of the dentition.

O085

Are museum 3D models still useful in planning neurosurgical approaches?

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This study was designed to investigate the use of anatomical models when planning the surgical approach for a patient with a trigeminal schwannoma having middle and posterior cranial fossae involvement.
As the anatomy of the skull base is very complex, the surgical approach required careful planning. An enlarged, 3D model of the ear displaying the relevant anatomy of the surrounding middle and posterior cranial fossae was used to plan the surgical approach for excision of this trigeminal schwannoma. The plaster model made in Germany in the 19th century, resides in the anatomical museum of the University of Aberdeen.
The model was studied in detail by the surgical team as it reproduced the anatomy of the temporal bone and surrounding neurovascular structures. All possible approaches were considered with the help of detailed, dissected anatomy providing excellent visualisation of the spatial relationship of the structures encountered during different skull base approaches.
The model was useful for the planning of the neurosurgical approach directed to the posterior cranial fossa. The spatial relationships of the anatomical structures involved were thoroughly revised and this was found to be useful in planning a proper surgical strategy. This model in particular contained a wide number of removable parts, mimicking cadaveric dissection, which was particularly helpful when considering all of the surgical options available.
3D anatomical models of the skull base are an excellent addition to or substitute for cadaveric dissection, for both anatomical learning and surgical planning. Despite advances in technology, the surgical team on this occasion found this model more useful in surgical planning. This serves as a reminder that sometimes 'old' models can still provide a valuable source of learning and that there is still room for an anatomy museum not only in medical school but even in surgical training.

O086

Branching pattern variation of the anterior circumflex humeral artery (acha) in relation to the long head of biceps tendon: clinical implications for biceps tenotomy/tenodesis

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Humeral head avascular necrosis (AVN), following arthroscopic rotator cuff repair using anchors is increasing (17 reported cases). Bone ischaemia/AVN when performing a biceps tenotomy/tenodesis or placing anterior suture anchors, may linked to the ACHA and its anterolateral ascending (AA) branch's close proximity to the intra-articular part of biceps (BT). Therefore, the purpose of this study was to investigate the course and branching pattern of the ACHA in relation to the BT. Thirty (15 male; 15 female), formalin fixed cadavers, left (n=28) and right (n=27) sides (total n = 55) were used (Ethical Clearance: 70/2017). The ACHA, with AA and descending (D) branches, were exposed from origin to termination. Origin, course and branching pattern were recorded. The ACHA originated as a single branch from the axillary artery in 77% (n=41/53) of the sample. Seven (I-VII) distinct patterns of variation were identified. Pattern I was most common (18/50; 36%), followed by II (14/50; 28%) and VII (9/50; 18%). Four patterns (III, V, VI & VII) were identified as potential risks for damage during biceps tenodesis/tenotomy. Normally, the ACHA courses posterior to the BT up to the lateral edge of the bicipital groove, before splitting into AA and D branches. The AA branch then courses superiorly, lateral to BT, before entering the medial edge of

the greater tubercle. However, in patterns III & VII, the AA branch is closely related to either the anterior or posterior surface of the BT in a sharp, oblique fashion, potentially placing this branch in danger during tenodesis/tenotomy. With pattern III, the entire ACHA is positioned anterior to the BT, making it a potential exposure risk. Surgeons should be aware of potential high risk variations during surgical approaches to reduce the risk of damage potentially leading to blood flow insufficiency and AVN.

O087

Investigation into the peak forces applied at the human wrist joint during reaming in total hip arthroplasty. An indicator of ergonomic risk?

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Orthopaedic surgeons have higher occupational risks compared to other surgical disciplines. This is a result of the high physical stresses, which are applied during operations. For example, during total hip arthroscopy (THA) large forces and torques are sustained when they retract muscles or use specialised equipment to ream the acetabula. However, there is limited data to characterise these stresses or highlight the injuries at risk when performing such procedures. The study aimed to assess the stresses which are applied to the orthopaedic surgeons' wrist, when reaming the acetabula in THA, under experimental conditions.

Ethical approval was obtained for this study under the Saxonian Death and Funeral Act (version 2014) and the Human Tissues Act of New Zealand (H17/20). Nineteen human acetabula were reamed consecutively with different reamer sizes and velocities. The acetabula were mounted onto a custom-built testing rig, the reamer was pushed into the acetabulum and the torques were measured using biaxial material testing machine (DYNA-MESS, Aachen, Germany). The noise affecting the measurements was removed by applying a low-pass filter to the data with the appropriate cut-off frequencies, as determined by Fourier analysis. The difference in peak torques between feed rates and the reamer sizes was statistically evaluated using an ANOVA.

The average peak torques of the reamer ranged between 2.0-2.5 Nm. Resulting in a force of 20-51 N applied to the wrist. A significant difference of the peak torques between the feed rates was found ($p=0.017$; $\eta^2=0.160$), however, no significant difference was noted between reamer sizes.

The sudden torque behaviour which occurs when the reaming tool reaches the subchondral lamella, could potentially contribute to the wrist injury, as shown by the peak forces and torques presented in this study. To reduce the risk of ergonomic injury at the risk during THA, torque limiters should be implemented in reamers.

O088

Medial Sural Artery Perforator Flap – cadaveric study

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The Medial Sural Artery Perforator Flap is a thin and versatile perforator flap, first described in 2001. Perforator flaps have evolved to be nowadays mainstay in reconstructive microsurgery because of the possibility of preserving function and better defect-donor area match. A major drawback in perforator flaps is their anatomical variability. Our aim was to perform a detailed anatomical study of the perforators from the medial sural artery and describe the characteristics of the flap.

An observational cross-sectional study was performed on 9 legs from 8 fresh cadavers at the Institute of Pathology. Through subfascial dissection, sizeable perforators were mapped and further dissected until the origin vessel. Surgically important variables were recorded.

A sizeable perforator was found in all legs, ranging from 1 to 3 perforators per leg, the median number being 2. The distance from the PC to the perforator ranged from 3 to 14 cm. The mean distance from the first perforator to the PC was 5.94 cm, from the second 10.5 cm and from the third 12.75 cm. The average pedicle length was 10 cm. The flap thickness ranged from 8 mm to 20 mm, with a mean value of 10 mm. The mean artery diameter at the site of takeoff from the common sural or popliteal artery was 2.03 mm ranging from 1.5 to 3 mm. The mean vein diameter was 2.94 mm.

The presence of a perforator in this location is almost universal, the pedicle length and caliber are reliable, and the thickness is usually low, making this a safe useful flap. A sound anatomical knowledge of the flap is essential for its surgical use, allowing benefits in terms of surgery time and reliability.

This study was performed in accordance to the Declaration of Helsinki. Ethics approval of was obtained by the CHLC Ethical Committee.

O089

Applied anatomical considerations for the surgical repair of human flexor digitorum profundus avulsions

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Avulsion trauma of the flexor digitorum profundus (FDP) at the distal phalanx (DP) is the most common closed flexor tendon injury in the hand. FDP reattachment surgery demands detailed anatomical knowledge of both the FDP and DP: inaccurate repositioning causes flexion deformities or decreased moment arm, and anchor fixation requires adequate bone dimensions. This study explores human cadaveric data to suggest surgical guidelines and precautions.

Dissections to expose the DP and attached FDP were performed on fresh-frozen human cadaveric fingers from bodies donated to The University of Edinburgh Medical School, under the Human Tissue (Scotland) Act 2006. Morphometrics of the DP and FDP insertion footprint, generated by methylene blue inking and tendon excision, were analysed in 47 fingers through digital images in ImageJ software. DP antero-posterior bone depth was measured at the proximal and distal points of FDP insertion in 96 fingers with digital calipers. Linear mixed effects models compared finger and gender variation.

FDP footprint:DP ratio means (±SEM), for all fingers and genders combined, were 22.26% (±1.11%) (surface area), 78.34% (±1.59%) (width) and 27.05% (±0.73%) (height of FDP footprint centre vs full DP height), similar for all fingers. Distance from distal interphalangeal joint (DIPJ) to FDP footprint centre was 5.16mm (±0.20mm) and to the footprint base was 2.55mm (±0.10mm), averaging all fingers; multiple significant differences existed between individual fingers and genders. DP bone depth was 6.20mm (±0.17mm) and 4.20mm (±0.06mm) at proximal and distal insertion points, respectively, averaging all fingers, with little fingers significantly smaller than all others. Depth at distal insertion points for all fingers in either gender was <5mm, suggesting horizontal placement of a commonly used 5mm micro bone anchor here would penetrate the posterior cortex. These results provide an important insight for surgeons when selecting optimal position and fixation technique for repair of an avulsed FDP.

O090

Anatomical classification of Tessier craniofacial clefts numbers 3 and 4 in a South African population

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Craniofacial clefts are rare occurrences with an incidence of about 1.43 to 4.85 per 100,000. Understanding the skeletal deformity in these clefts is basic to any reconstructive surgery of the face. This study documented the skeletal defects present in Tessier numbers 3 and 4 using anthropometric measurements in order to generate a sub-classification which will improve the means of communication between surgeons managing the disease.

Seven CT scans of patients who had been treated for Tessier 3 and 4 clefts between 2003 and 2017 were analysed and measurements of the expected defects in each cleft taken with the unaffected side of the face as the reference. Ethical clearance was sought from the Biomedical Research Ethics Committee of the University of Kwazulu-Natal and the Department of Health, Kwazulu-Natal Province. Emerging patterns were then used to generate a sub-classification for these clefts. The reliability and validity of the measurements were ensured by allowing the data to be examined by both an intra and inter observer.

There were 5-Black and 2-Indian South Africans in the 7 scans that were included in the study. Some had bony clefts while others didn't. The average location of the clefts was 7.3mm (2.2) from the midline while the cleft sizes averaged 12.4mm (7.9). the orbit and the maxilla showed varying patterns in their measurements when compared with the unaffected side.

The study came up with a sub-classification based on the results with a designation of (a) or (b) for the presence or otherwise of the bony cleft and (o), (i), (ii), (iii) and (iv) for the various patterns shown by the orbit and maxillary bone measurements when compared to the unaffected side. This sub-classification will improve the way these clefts are communicated amongst physicians charged with their management.

O091

Triangle of Calot: why we should stay with his original boundaries as described in 1892

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Dr. Françoise Calot in 1892 described the triangle with the following boundaries: the cystic artery superiorly, the cystic duct inferiorly, and the common hepatic duct medially. In 1995, Dr. Steven Strasberg described the importance of obtaining a "Critical View of Safety" during laparoscopic cholecystectomy. These papers have guided surgeons in reducing complications during laparoscopic cholecystectomy. These descriptions, however, do not take into account other major structures within this area. Hence, Dr. Nathan Ozobia introduced the concept of the Hepatocystic Space and the Hepatocystic Quadrangle at the EB 2019 convention in Orlando, Florida.

The Hepatocystic Space is bounded by the hepatoduodenal ligment medially and the gallbladder laterally when held in the laparoscopic surgical position. Within this space lies the Hepatocystic Quadrangle with the following boundaries: inferiorly, from the neck of the gallbladder to the hepatoduodenal ligament; laterally, from the neck of the gallbladder to the right lobe of the liver; medially, the hepatoduodenal ligament; and superiorly, the line between the lateral and medial borders. This space is bisected vertically and horizontally into four quadrants, Q1-Q4.

Q1 contains the Triangle of Calot as well as the Critical View of Safety. This should be the main working space during cholecystectomy. Q2-4 contain major biliary structures and vasculature that should not be aggressively interrogated in most cases.

This study consisted of surgical observation by the authors during cholecystectomy. Dissection was limited to outlining the contents of quadrant Q1. Informed decisions were made regarding the

imaginary boundaries of Q2-Q4, and in select cases judicious dissection was performed. No ethical approval was required.
Many vital structures are at risk in cases of difficult cholecystectomy. Therefore, knowledge of Calot's original triangle, Strasberg's critical view, and now the Hepatocystic Quadrangle provide anatomic roadmaps that can assist surgeons in further reducing the complication rate of cholecystectomy.

O093

Analysis of Myofascial Trigger Point-Prone Regions in Trapezius: Novel Insights from Cadaveric Data

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The etiology and pathophysiology of myofascial trigger points (MTrPs) associated with myofascial pain syndrome (MPS) are poorly understood. A thorough understanding of where, how, and why MTrPs occur within a muscle is critical for the development and assessment of clear diagnosis and treatment protocols. One of the most commonly studied muscles in MPS research is trapezius. In this cadaveric study, we examined regions of trapezius frequently associated with MTrPs to investigate whether these areas exhibit any unique architectural characteristics. Ethics approval was obtained from the University of Toronto Health Science Research Ethics Board (#27210). We used 3D cadaveric dissection, digitization, and modeling approaches to collect and quantify data from 8 adult trapezius muscles (4M/4F). Features of MTrP-prone regions were analysed using quantitative architectural parameters and qualitative visual inspection. The most notable feature of MTrP-prone regions was their correlation with areas where connective and contractile elements of the muscle meet: musculoaponeurotic junctions. Additional research investigating tissue properties (e.g. elasticity and vascularization) are necessary to fully understand why MTrPs appear to form in areas coincident with musculoaponeurotic junctions. We present and contextualize these novel data within the broader scope of recent MPS literature, with an emphasis on the underlying mechanisms that may contribute to MTrP formation, as opposed to diagnostic criteria and treatment. In particular, we emphasize how data from cadaveric studies may provide unique insights into MTrPs: a phenomenon that remains enigmatic in many respects to researchers and clinicians alike.

O094

The Impact of Iliac Artery Anatomy on Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA)

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Non-compressible torso haemorrhage is a leading cause of traumatic mortality. Trauma patients often exsanguinate to death prior to definitive haemostasis. An emerging method of treating patients in a prehospital environment is to deploy an intra-aortic balloon pump to halt blood loss, resuscitative endovascular balloon occlusion of the aorta (REBOA). REBOA utilises the femoral, external and common iliac arteries to gain access to the aorta. The ease of access to the aorta can have a direct impact on the success of such interventions. The aim of this study is to determine if iliac tortuosity or lumen diameter impacts on the time taken to perform REBOA.
This study was carried out in seven, soft-fixed embalmed cadavers (3 male; 4 female). All cadavers had their abdomens and thorax opened by a midline incision. Complete removal of the heart, lungs and abdominal organs allowed clear access to the posterior abdominal wall. The aorta was intact from the arch to the lower limbs. REBOA was performed on the cadavers. A tortuosity index and diameter of the external and internal iliac arteries was measured.

There is a strong positive correlation between tortuosity and time to occlusion (R2= 0.89). The correlation between lumen diameter and time to occlusion is substantially weaker (R2= 0.11). Qualitative data was also taken, it was found that in cadavers with more tortuous arteries more resistance to inserting guide wires was felt. Furthermore all cadavers with a tortuosity index ≥1.35 had their vasculature damaged by the REBOA procedure.
This data suggests that having tortuous vasculature not only delays the time to complete aortic occlusion but also increases the risk of complications.
Ethical approval was not required. All donors have given written consent for anatomical examination prior to their death.

O095

Biomechanical characterization of the human temporal muscle fascia as a graft material for dura mater reconstruction

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The human deep temporal muscle fascia (TMF) is widely-used as a graft material in the craniofacial region, including dura mater reconstructions. To date, a comprehensive biomechanical characterization of the TMF is lacking, impeding the thorough comparison of the TMF to other graft materials. Moreover, the influence of donor age and time between harvest and implantation of the TMF on its biomechanical properties is unknown. In this study, we investigated the biomechanical properties of 74 fresh human TMF samples (age range 4 months to 93 years) obtained during forensic autopsies (ethics approval obtained from Leipzig University, protocol number 486/16-ek). These results were compared to the ones of the recently investigated dura mater from an age-matched group, in order to assess the biomechanical suitability of TMF as a dura mater substitute. A highly standardized testing setup was used, including 3D-printing, digital imaging and the adjustment of the tissues' water content to the in vivo state. The TMF revealed an elastic modulus of 36 ± 19 MPa, ultimate tensile strength of 3.6 ± 1.7 MPa, a maximum force of 16 ± 8 N and a failure strain of 17 ± 6 %. The post-mortem interval of TMF correlated weak with the elastic modulus (r=0.255, p=0.048) and the strain at failure (r=-0.306, p=0.022). The elastic modulus of the TMF was significantly higher in males (40 ± 20 MPa) than females (28 ± 11 MPa; p=0.003). Age of the donors did not show significant correlations to the mechanical parameters of the TMF. Compared to the dura mater, the TMF showed a significantly lower elastic modulus and ultimate tensile strength, but a larger failure strain. The TMF with a post-mortem interval of up to 146 hours may be considered a mechanically suitable graft material for duraplasty when stored at a temperature of 4 °C after harvesting.

O096

The MRCS Examination - anatomical assessment for surgeons

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The MRCS (Membership of the Royal College of Surgeons) is an intercollegiate postgraduate examination for surgeons in training in the UK and Ireland. The examination is overseen by a body of surgeons, basic scientists and Heads of Examinations. It marks the completion of core surgical training and readiness for higher specialist surgical training. It has both MCQ and

OSCE components and covers a number of broad content areas that are fundamental bases on which to build specialist surgical knowledge. Surgeons must have a good understanding of basic sciences and one could argue that, in the operating theatre, anatomical knowledge is the most important of them all. The structure and governance of the examination will be outlined.

O097

Human Placental Corrosion Cast Studies - a technical note

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Analysis of vascularization of the human placenta (HP) is important in the medical sciences. Abnormalities of its blood supply lie at the basis of many fetal diseases and may be responsible for the development of various illnesses in adults. Obtaining high numbers of vascular macroscopic preparations provides an opportunity for comparative test conduction between healthy and pathological HP. Aim of the study: establishment of a high quality, easy to analyse visualization technique for large villous vessels with a relatively low financial cost and workload. In order to develop and further improve the methodology 50 fresh, HP taken from healthy participants were used. Newborns were healthy, born on time without any abnormalities. The study obtained a consent of the local bioethical commission. The technique of performing of HP corrosion specimens consisted of several stages. Firstly, in order to prevent the activation of the thrombotic process, an anticoagulant was administered. The HP was then visually inspected and prepared for vascular access. The next stage was an insertion of two catheters independently into venous and arterial vessels. The depth of the catheter insertion was adjusted so that about 5cm of the length of the umbilical vessels measured from the villous plate remains uncauterized. Then, usually a dose of anticoagulant is required for final vascular decongestion. The last stage of the procedure was corrosion using inorganic bases. This technique of making corrosive preparations of the HP seems to be an interesting method allowing for macroscopic evaluation of umbilical artery branches and umbilical vein tributaries. Its advantages include speed of implementation, repeatability and low cost. The most important disadvantages are the fragility of the castings and technical difficulties associated with vessel catheterization. Currently, research is being conducted on the use of this method in comparative evaluation of vascularization in normal and pathological HP.

O098

An Investigation into the Effect of Anatomical Fixative Techniques on Connective Tissue Properties within the Head and Neck

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Thiel-fixed cadavers have been shown to have greater flexibility of musculoskeletal components when compared to the gold-standard formalin-fixed tissue. However, there is limited craniofacial data on comparative properties of connective tissues found within the head and neck region. Purpose of this study was to examine the effect of fixation type and mode of dissection on 2 groups of muscles – [1] Masticatory and [2] Facial Expression - using parameters of muscle volume and mobility of the temporomandibular joint (TMJ). Muscles were measured in-situ (pre-dissection) using electronic callipers and ex-situ (post-dissection) using water-displacement to determine muscle volume (n=8). TMJ mobility was measured using a goniometer to measure angle of movement from a “closed” to an “open” mouth position to establish jaw gape (n=9 formalin-fixed, n=11 Thiel-fixed, and n=10 fresh-frozen). It was found that formalin-fixed muscles in both groups (masticatory and facial expression)

tended to over-estimate volume when measured in-situ whereas the opposite was true for Thiel-fixed muscles which showed volume underestimated in-situ. This could be due to excessive flexibility of Thiel muscles redistributing from their anatomical position. It was found that the type of fixation (Formalin vs Thiel) affected the volume of the larger masticatory muscles with the Thiel-fixed group exhibiting larger volumes when compared to the Formalin group. However, this trend did not continue with the smaller, mimetic facial muscles which were not affected by fixation type. The mean degree of movement (jaw gape) of the TMJ in Thiel-fixed specimens was found to be significantly higher than that of formalin and fresh-frozen ($p \leq 0.001$). Fresh-frozen and formalin-fixed measurements had a mean jaw gape of 12˚ whilst the Thiel-fixed measurement had a mean of 25˚ - almost double - suggesting that Thiel-fixation has caused the TMJ to become hypermobile.
Ethical approval by the UoL (Application number: 201611125) and HTA guidelines

O100

Cortical and trabecular bone density distribution in the human lower limb

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Skeletal design consists of a compromise between having a stable body and a light design that is energetically inexpensive to grow, maintain, and move. Studies show that greater mass is allocated in the proximal limb elements relative to the distal, especially among cursors. Additionally, experimental work suggests that periosteal modeling (adds mass) is significant in proximal limbs whereas, Haversian remodeling (repairs microdamage) is greater in distal limbs. However, data suggest that low trabecular bone mass and density decrease in a proximal-distal fashion even among non-cursors and across modern human groups with diverse subsistence strategies. Furthermore, it has been reported that distal limbs do not remodel more than the proximal in humans, contrary to the expectation of a decline in mass along a proximal-distal gradient. This study investigates the difference in trabecular and cortical bone density in recent human populations. We predict that across populations, trabecular density decreases proximal-distally due to its lability, while cortical density remains relatively high throughout to maintain a stable limb. We measured trabecular and cortical bone density in lower limb epiphyses in five recent human populations (N=>15 each) using pQCT scanning. Results show significant proximal-distal decline in cortical density across populations, although some variations exist. In contrast, trabecular density exhibits a significant decline proximal-distally among human populations with active lifestyles i.e., foragers. These results suggest that distal limb elements have low cortical density potentially to minimize mass, irrespective of activity level. Additionally, because trabecular bone is labile, it likely experiences more modeling and remodeling, especially when greater loads are applied to the limb. Thus, cortical and trabecular bone respond differently to loading. While activity levels may have a significant impact on loading, general evolutionary trends exist across mammals ensuring limbs remain lighter distally. This is significant in our understanding of evolutionary trade-offs.
Ethical approval not required

O101

A phylogenetic reassessment of the primate quadratus plantae muscle

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Much discourse focuses on the unique aspects of the human foot skeleton. This study differs by emphasizing muscular features. Data are drawn from dissections of 67 humans, 13 chimpanzees, and 13 baboons. Discussion focuses on quadratus

plantae and its anatomical relationships within the foot.

Some form of quadratus plantae exists in many primates. Humans are conventionally associated with medial and lateral heads arising from the calcaneus. Dissection observations of humans found more variations. Specifically a muscle represented solely by its lateral head, solely by its medial head, with a superficial and deep head, as a belly without a medial-lateral divide, and sometimes quadratus plantae was found to be absent. In chimpanzees it was found to be absent or represented by an equivalent to the lateral head that was so reduced as to be functionally absent. The most common condition found in baboons was a relatively large single belly from the lateral calcaneus, although it was sometimes also represented by a single medial head and occasionally it was found to be absent.

The literature describes the medial head of quadratus planate as being uniquely human. This begs the question on its evolutionary developmental origins. A heretofore undescribed feature is the muscular quality of the flexor (tibialis) digitorum longus tendon within the chimpanzee foot. This muscularity could provide the same flexor adjunct function as might be expected of a quadratus plantae medial head. The absence of quadratus plantae is generally considered to represent a more derived anatomy in the chimp foot, and that may still apply inasmuch as it references the lateral part of the muscle. However, this muscular tibial flexor tendon may represent a transitional condition within the human-chimp clade.

All human cadavers were voluntary participants in the University of Wisconsin Anatomical Body Donor Program. No further ethical approval was required.

O102

Facial masculinity-femininity and measures of health in a Sub-Saharan African population

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Masculinity, especially in males, has been suggested to signal innate immunity to infections because it reflects an individual's ability to resist the immunosuppressive effect of high testosterone levels. The present study introduces a method for quantifying faces on a masculinity-femininity gradient and seeks to determine whether there is a relationship between individual measures of health and masculinity scores. The faces of 426 participants (215 males, 211 females) from the Hausa ethnic group in Nigeria were scanned (with their consent and ethical clearance) with a 3D surface laser scanner. Thirty-five facial dimensions were found to be sexually dimorphic following 2-sample t-tests and were subjected to Principal Component Analyses. Masculinity-femininity (FacM) scores were generated from 8 Principal Components that described most of the variation in the data using Discriminant Function Analysis. Results implied that measures of health including body mass index, systolic and diastolic blood pressures do not co-vary substantially with FacM scores in men or women (all $R2<0.01$; $P>0.05$). However, for women Spearman' rho correlation indicates a positive relationship between FacM scores and a summary metric of the total combined disease history of participants and their mothers during pregnancy (rho= 0.25, $p<0.0001$). This may imply that women are more susceptible to the immunosuppressive effect of variation in testosterone levels than men, or that more masculine traits in women are favoured in socio-economic contexts where disease load is higher.

O103

Sex and ancestry estimation of South African Coloured crania using 3D-ID

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High crime rates result in many unidentified skeletal remains which forensic anthropologists are called upon to assess sex and ancestry contributing to the identification of the individual. The software program 3D-ID, employs geometric morphometrics by digitising cranial landmarks for the estimation of sex and ancestry. 3D-ID is a fairly new, freely available program that has a large reference database of over 2000 individuals. The database contains a small sample of African individuals however doesn't include South African coloured (SAC) individuals. The term "coloured" is a social term used to define individuals of mixed ancestral heritage including native Africans, European colonists, and individuals descended from slaves brought to South Africa. The SAC population has a large amount of biological differences compared to other African populations that could affect ancestry estimation. The current study therefor assessed the performance of 3D-ID in estimating sex and ancestry of 150 SAC individuals. This research has been conducted under the ethical waiver reserved for the School of Anatomical Sciences, University of the Witwatersrand. The analysis was broken down into both shape and form. The analysis using form variables achieved higher sex classification accuracies, ranging from 52% to 78.67%. When using both shape and form variables, for ancestry estimation SAC individuals were classified mostly as Southwestern Europeans with accuracies ranging from 34.67% to 57.33%. When using form variables SAC individuals are classified as African and South American with accuracies ranging from 18.67% to 28.00%, while shape variables classified SAC individuals as African with accuracies ranging from 16.00% to 32.00%. We conclude that 3D-ID exhibited poor reliability for ancestry estimation and moderate reliability for sex estimation. Any interpretation of 3D-ID's results should be cautiously analysed until South African data can be included in the 3D-ID database.

O104

The impact of hyperkyphosis on breathing and locomotion

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Scheuermann's disease is characterised by an increased anterior vertebral wedging causing hyperkyphosis of the thoracic spine. Morphological adjustments related to the orientation of the sacrum were previously described. Nevertheless, there is little information regarding the morphology of the rib cage in individuals with Scheuermann's disease, despite its proximity to and direct articulation with the thoracic vertebrae. The aim of this study was to reveal morphological changes in the rib cage in hyperkyphotic individuals.

For this purpose, 370 individuals from the Hamann-Todd Osteologic Collection (Cleveland, Ohio, USA), with (n= 194) and without (n=176) Scheuermann's kyphosis were included in the study. Information regarding individuals' age, sex, and ethnicity was recorded. Ethical approval to work with ancient human material was granted by the Cleveland Museum of Natural History.

Linear and angular measurements of the sternum (length and width), ribs 5 to 9 (length and depth), and thoracic vertebrae (transverse process angle of T5 to T9) were carried out. Indices were calculated from these measurements. Significant modifications in the morphology of ribs and sternum were found. In the kyphotic group the sternum was significantly wider and the ribs were significantly longer compared to the control group. The attachment region of the longissimus muscle, however, was significantly smaller in the

study group compared with the control group. Nevertheless, the orientation of the rib cage did not differ significantly between the groups.
To conclude, rib cage morphology undergoes considerable modifications in individuals with thoracic hyperkyphosis. The modifications mostly affect the anterior part of the rib cage and its proportions. Moreover, the relative attachment area of the longissimus muscle is smaller. All this might affect the functionality of the rib cage in breathing, posture and locomotion.

Poster Communications

P1-AT1

Importance of dissection for academics in the health sector

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Dissection consists of the systematic exploration of a cadaver, preserved by the sequential division of layers and tissues. This method provides an important teaching/learning tool for academics of health related courses. This study aims to use the dissection method as a teaching tool. The present study was based on the project of cadaver dissection techniques of the Federal University of the Triângulo Mineiro, which occurred in 2018. The following materials were used: cadaver fixed in formaldehyde (4%), anatomical tweezers, scalpel No. 3, blades 10 and 11, anatomical scissors and gloves. The presentation of surgical equipment, dissection techniques, and practice guidelines were applied and supervised by the professor responsible for the project. After the dissection, students underwent a learning assessment through a closed questionnaire that verified how the dissection technique contributed to the learning within the discipline of human anatomy. The study was submitted to the Brazil Platform and approved by the Research Ethics Committee under the number 47180. Through the questionnaires completed by the participants it was observed that dissection used as a teaching method improved the learning of location and visualization of anatomical structures in three dimensions, it improved dexterity as well as enhanced ability to view anatomical variations and to follow complex instructions, furthermore, it improved the way that death related issues are dealt with. In this project, dissection is presented as a great tool for the recording of anatomical knowledge, making it possible to be used as a methodology for anatomical revision. No statistical analysis were made. Therefore, dissection is an excellent complementary resource for academic training in human anatomy, providing a solid base for other disciplines involved in the health sector.

P1-AT2

Novel Contrast Agent and Illuminating 4D Helical Micro CT Scanner Reveals Detailed Human Vascular Anatomy Visualisation from a Donor Cadaver

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Medical imaging technology and contrast agents regarding human sectional anatomy have reached a plateau clinically, but scientifically perhaps not a ceiling. Typical hospital CT and MRI scan widths enable clinicians to identify most pathologies sensitive to cross-sectional slices with and without contrast and/or when rendered into 3-D imaging. The objective of this study was to investigate if an alternative contrast agent perfused into a donor cadaver using 1 of 2 4D Helical Micro CT scanners worldwide could improve visualisation of human vascular anatomy. Literature search revealed no known published manuscripts using a new contrast agent which does not exit vessels to reveal medium sized (2-5 mm), small (1-2 mm), very small (less then 1mm) and micro (less then 100 microns)

vessels. A barium sulfate derivative was successfully perfused into donor cadavers. 4D Helical Micro CT scanning was conducted post perfusion and viewed with desktop computer software and Sectra visualization table for 3D rendering. The perfusion technique and scanning was successful in revealing detailed human vascular anatomy (micro, 12-40 microns) from donor cadavers. DICOM files were successfully rendered into 3D images using Sectra revealing micro vasculature. This study successfully conducted a unique perfusion technique to donor cadavers with a novel contrast agent illuminating not previously viewed micro vasculature imaging from a 4D Helical Micro CT. IRB approval granted for cadaver research.

P1-AT3

Clerking an unknown human skull- a clinical approach to craniometry

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Evidence supporting the use of craniometric analysis is robust. Although, it is not necessarily accessible to those who lack an appreciation of the intricacies, including undergraduate medical students. Students may experience cadaveric dissection or observe a post-mortem, but craniometry is rarely studied.
The purpose of this research was two-fold: firstly, to determine the approximate age and authenticity of a resin-set human skull donated to Brighton and Sussex Medical School, and secondly, to determine if a clinical approach to the task is a viable way to engage with medical students.
An initial clinical clerking proforma was devised. Measurements of the skull were then taken using tape measures and Vernier callipers to demonstrate the key craniometric principles. These measurements include the thin layer of preserving resin <1mm and also some areas of soft tissue (e.g. the external carotid artery) and hence were not true measures. To address this issue, a CT head was performed which allowed for accuracy in measurement as the areas of soft tissue could be subtracted from the measurement to give a true value.
The CT also allowed for authenticity to be studied. By examining the deciduous dentition and comparing craniometric measurements taken with accepted standards, the skull was found to be that of a juvenile human. Using the measurements taken from the CT scan, and analysis of the dental structures, the skull was estimated to be that of an 8-9-year-old child.
Whilst the physical measurements taken were not used in the estimation of age; the process of precisely identifying such anatomical landmarks and palpating the key structures was invaluable in building understanding. Applying a familiar, clinical approach to this unfamiliar task was successful in maintaining interest and demonstrating many key craniometric concepts.
This study was conducted in line with Human Tissue Authority Codes of Conduct.

P1-AT5

Morphometric and biomechanical investigation of the male urinary bladder to understand bladder ruptures caused by pelvic trauma

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The interrelation between anatomy and biomechanics of human male urinary bladder has been of much interest, especially in cases of bladder ruptures caused by pelvic trauma. To envisage the anisotropic behaviour of the urinary bladder, the study aims to define relevant bladder geometry and investigate the feasibility of finite element (FE) male urinary bladder model construction through the Finite Element for Biomechanics (FEBio) pre-processor PreView interface. Mean morphometric parameters of the bladder and pelvic structures were collated,

translated and implemented in the FE model, considering all material and structural properties through numerical discretisation. Morphometric measurements taken from 16 cadaveric specimens were translated to three-dimensional pelvic geometry as 11 primitive shapes and nine attaching structures, with corresponding boundary conditions and rigid constraints assigned to mimic in vivo biomechanical interactions. All cadaveric specimens were used in accordance with the Human Tissue Act 2004. Uniform tetrahedral meshing of the bladder was utilised to accommodate its quasi-linear deformity. Though various anatomical, morphological and mechanical limitations were raised, the final FE bladder model effectively translated the observed two-dimensional morphometric parameters to primitive three-dimensional structures, enabling a clearer apprehension of the anatomical relations of the urinary bladder. Furthermore, with the majority of current FE models targeting female bladders, this male-specific bladder model addressed the distinct anatomical differences between the sexes. Different levels of bladder distension (void, intermediate and full) relative to the modelled pelvic parameters were also taken into consideration. This preliminary investigation of FE urinary bladder analysis paved way for future iterations and refinement of pelvic geometry for a more realistic representation of the in vivo bladder. Dynamic problem domain analysis coupled with subsequent trauma simulations would complete the finite element bladder model; enabling a deeper understanding of the underlying biomechanics and anatomy of the male urinary bladder, to better predict and treat bladder injuries.

P1-AT6

Scanning Electron Microscopy (SEM) used as a tool to assess the nail plate

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The nail plate is usually affected by a number of pathologies, including onychocryptosis, onycholysis, onychomycosis among others. However, little is known about the potential role of variations in nail lamina structure, thickness, and composition and its susceptibility to pathologies. The aim of the study is to investigate if SEM can be used as a tool to assess the ultrastructure and determine quantitatively the composition of a healthy nail plate and contribute to its characterization.
The study was carried out with the permission of the University Bioethics Committee (Reg. 116/2016). Our analysis focused on 12 samples of nails, corresponding to 6 women of 35±15 years and 6 men of 40±19 years, which were collected using a cutting tool. The nail clippings were cleaned by immersion in an ultrasound bath to remove skin cells under the nail plate. The samples were fixed, dehydrated and dried under CO2 and subsequently sputter-coated with gold and examined under SEM in high vacuum conditions, to analyse the ultrastructure and the thickness. Additional quantitative composition analysis was performed under low vacuum conditions on samples previously embedded in polyester resin and smoothen.
The use of the SEM allowed distinguishing clearly the ultrastructure of the nail plate as well as accurate measurements of the relative and total thickness of its layers. Concomitant composition analysis revealed carbon, oxygen, nitrogen, and sulphur as the main components of the lamina. Despite the low number of samples analysed, this work indicates the suitability of the SEM as a tool to analyse the ultrastructure and composition of the nail plate from a quantitative point of view and its potential use to identify differences in the pathologic nail plate.

P1-AT7

The prevalence of Gantzer muscle in the Israeli population

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The muscular variations in the forearm flexors have an important role in clinical practice. The Ganzer muscle (GM) was first mentioned in 1813 and later described as two accessory muscles connecting the superficial layer to the deep layer of the anterior compartment of human forearm: (1) as the accessory muscle of the flexor digitorum profundus (AFDP) and (2) as the accessory muscle of the flexor pollicis longus (AFPL). This variation may affect the function of the flexor compartment and lead to forehand and hand pathologies, such as the anterior interosseus nerve syndrome.

This work aims to describe the prevalence of GM using a dissection approach. A large sample consisting of 176 forearms of 88 cadavers (39 males and 49 females) were carefully dissected. The presence of AFPL and AFDP was systematically detected and recorded and statistical analysis was conducted according to gender and muscle's side. Results suggested a high prevalence of AFPL, 60.2% of the dissected cadavers. In 34.1% of cadavers, AFPL was bilateral. Unilateral prevalence was equal for both sides. Presence of AFPL muscle was similar in males and in females (61.5% and 59.2% respectively, χ^2=0.050, p=0.823). Nevertheless, within the unilateral cases, males have a significant difference in the prevalence between left and right (5.1% and 25.6% respectively, p<0.05). AFDP was recorded in 20.5% of the sample.

The prevalence of GM is very high, however, there is not systematic research to detect it. As to our knowledge, this current study is the largest ever conducted on the GM and is the basis for upcoming studies carried out with ultrasound on living population. Future research will explore the correlation of GM with forehand and hand pathologies (such as windblown hand, tennis and golf elbow), and the GM implication in manual activity and in the evolution of the Homo sapiens hand.

P1-AT8

Bone Preparation from Embalmed Human Cadavers – A Retrieval and Curation Technique

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Bone preparation involves soft tissue removal, maceration, bleaching and labelling. In the absence of a standardized method, a large repository of human bones is lost, as most medical colleges do not process the bones after the dissection of human cadavers. Therefore, present study was conducted with the aim of evaluating least time consuming and effective method for bone preparation.

To standardize a method of bone preparation (retrieval and curation) from embalmed and wet specimens of human cadavers using a combination of bone cleaning techniques for anatomical studies. Methods:

1. Removal of soft tissue
2. Maceration:
   a. Soak the bones in tap water for 24 hours for softening.
   b. Remove soft tissues, which are still left, by gentle scraping.
   c. Boil bones in water for 2 hours.
   d. Add Potassium Hydroxide (KOH) pellets.
3. Bleaching: Soak all the bones in Hydrogen Peroxide (H_2O_2)
4. Degreasing; Wash the bleached bone with water and soak them in Acetone
5. Drying: Spread the bones on blotting paper
6. Finishing: Paint the bones with a mixture of half litre lacquer and half litre lacquer thinner (alternately by painting with Johnson Touchwood®).

Boiling in combination with other bone cleaning techniques macerates bone in a remarkably fast and odourless way. The bones retrieved were ivory coloured and less brittle and can be preserved for a longer duration even after repeated usage.

There has been considerable debate among anatomists and anthropologists as to how the

remains of human cadavers should be macerated. However, we have been experimenting with this method and conclude that retrieval of bones using boiling in combination with various bone-cleaning techniques is very effective.
This technique was applied on voluntarily donated dissected human cadavers used for undergraduate teaching in the department of Anatomy and therefore ethical approval was not taken.

P1-AT9

Thyroid IMA artery of Neubauer and clinical relevance

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Thyroid-ima is an artery that is normally found during fetal life and occurs as an anatomical variant in 3–10% of the population. Johann E. Neubauer German anatomist first described it in 1772 and hence it has since been referred to as the thyroid ima artery of Neubauer. The artery originates lower than the inferior thyroid arteries, so it is also known as the lowest thyroid artery. During Routine Cadaveric Dissection for MBBS Students-2018 batch in the Department of Anatomy, Kurnool Medical College, Kurnool, While Dissecting the Neck the Unusual origin and course of the thyroidea ima artery in a male cadaver. The Thyroid ima artery originated from the right Brachiocephalic Trunk. The ima artery coursed anteriorly between the internal jugular vein and left common carotid artery and It then runs obliquely below upwards, reached the inferior pole of left lobe of thyroid and branched repeatedly to supply the both lobes of thyroid gland and isthmus. The thyroidea ima artery is an uncommon variant of the blood supply to the inferior aspect of the thyroid gland. It can arise from; Brachiocephalic trunk, Right common carotid artery, Aortic arch, Internal thoracic artery The Thyroid ima artery is present in approximately 3–10% of the population and ima artery is of surgical importance due to infrequent presence and its relatively small size and it can cause as severe bleeding in surgery of the thorax, trachea, thyroid or parathyroid glands. Percutaneous tracheostomy is a minimally invasive operation performed in patients, in order to provide an air passage through the windpipe. The rare cause of severe bleeding during such operation is the injury of the thyroidea-ima artery.
No ethical approval was required

P1-AT11

Ultrathin sheet plastination in a shoulder rat model of monosodium iodoacetate induced osteoarthritis for neovascularization identification

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The monosodium iodoacetate injection (MIA) is widely used to produce experimental osteoarthritis (OA). Ultra-thin sheet plastination has been used to study the morphology of various anatomical structures. However, we could not find in the literature investigations that use plastination as a methodology for the identification of morphological changes caused by pathologies. The aim of this study was to do ultrathin sheet plastination in MIA-induced osteoarthritic rat humeral joints to visualize the OA neovascularization.

Ten left humeral Sprague-Dawley rat joints were injected with 0.1 mL of MIA. Right humeral joints were used as control. Sixteen weeks after the injection, the animals were euthanized and were given an immediate epoxy red resin injection through the thoracic aorta. Humeral joints and surrounded tissue were fixed in 10 % formalin, prior to the plastination process, without decalcification. Samples were dehydrated with acetone (100 %) at -25 ºC, for ten days. Later, for degreasing, samples were immersed in methylene chloride at room temperature during one week. Forced impregnation was performed inside a stove within a vacuum chamber. The plastinated blocks obtained were cut with a slow velocity diamond blade saw. Slices were placed in curing chambers to achieve the polymerization and final tissue transparentation. 230 µm thickness slices were obtained. The slices were analyzed under magnifying glass and microscope, achieving visualization of OA neovascularization.
The cartilage affected by OA loses its ability to remain avascular, and blood vessels invade it from the subchondral bone to the calcified and uncalcified cartilage. Ultra-thin sheet plastination is useful to observe articular cartilage neovascularization, caused by OA induced with MIA in humeral rat joint

P1-AT12

A combined method to reduce formaldehyde exposure in human gross anatomy classes

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Formaldehyde is an extraordinarily effective fixation for human bodies. Thus, most embalming solutions for donor cadavers in gross anatomy are based on formaldehyde. In 2004 the International Agency for Research on Cancer (IARC) classified formaldehyde as carcinogenic (group 1A) to humans. The European legislation followed this risk assessment 10 years later. Thereupon, a legal permissible exposure limit (PEL) of 0.3 ppm was introduced in Germany. Only Israel, The Netherlands and Japan have stronger limits of 0.2, 0.12, 0.1 ppm. Yet, to prevent any risk of infection for students and teachers the required concentrations of formaldehyde result in formaldehyde loads of the air around the dissection tables far above these PELs. To reduce the emission of typically formaldehyde fixed bodies (3% formaldehyde) in our dissection classes, two different techniques were applied to undercut the limiting PEL. Additional air was directed onto the cadavers by three long throw nozzles positioned at the ceiling exactly over each formaldehyde fixed body. This additive ventilation reduced the formaldehyde exposition by about 60%. A chemical method using InfuTraceTM to polymerize the residual unbound formaldehyde within the bodies gave a further 70% reduction. The combination of both methods reduced the inhalation exposure by about 90%. The recorded concentrations did not exceed 0.1 ppm during skin and muscle dissection and 0.04 ppm during organ dissection. The combined system worked particularly efficient to keep extremely low formaldehyde exposure values, even under extreme climate conditions with outside temperatures of 38°C and a relative humidity of 85% inside the dissection hall. The low exposure levels were validated by independent measurements performed by an official governmental authority (Regierungspräsidium Kassel). In summary, these ingenious simple and cost effective techniques can be adapted to any given dissection classroom and to any formaldehyde embalming solution by adjusting the nozzle system and the concentration of InfuTraceTM.

P1-CM4

Common variant of FTO gene, rs9939609 is associated with obesity in Myanmar adult

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Obesity is a global health problem that can give rise to multiple obesity related diseases. Genetic susceptibility plays a critical part in increasing the risk of obesity. The objective of this study was to find out the association of fat mass and obesity associated (FTO) gene rs9939609 polymorphism with BMI status in Myanmar adult. This study was done with the approval of Research and Ethics Committee, University of Medicine 1, Yangon, Myanmar. A total of one hundred and thirty six adults between 18-60 years were involved in this study. After taking informed consent, body weight, height, waist circumference and hip circumference were measured. BMI and waist hip ratio (WHR) were calculated and categorized into two groups such as obese (≥ 30 kg/m2) and non-obese (< 25kg/m2) on BMI scale. DNA was extracted from the whole blood by using QIAamp® DNA blood mini kit (Qiagen, Germany). PCR-RFLP was performed by using specific primers, Taq PCR Core Kit (Qiagen, Germany) and fast digest ScaI restriction enzyme (Thermo Scientific, USA). Among 136 adult subjects, the genotype distribution of rs9939609 FTO SNP were as follow, 14 (10.3%) had homozygous (AA) genotype, 47 (34.6%) had heterozygous (TA) genotype and 75 (55.1%) had wild type (TT) genotype. The high risk homozygous (AA) and heterozygous (TA) genotype were more common in obese subjects compared to non-obese subjects. The risk "A" allele of this polymorphism was found in 27.6% of study population and normal " T " allele was seen in 72.4%. The obese subjects had 6 times more risk of risk "A" allele expression than non-obese subjects (95% CI = 3.2 – 11.2). The present study demonstrated that the rs9939609 FTO polymorphism was associated with increased risk of obesity.

P1-CM5

Correlation between leptin receptor diversity and osteoporosis in Chinese Mulao population

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Osteoporosis is a degenerative disease with reduced bone mass. Leptin receptor (LPPR) may be the genetic factors related to OP. This study aimed to explore the association between leptin receptor gene diversity and osteoporosis in the Mulao population.

A total of 438 Mulao people from Guangxi over 45 years old were selected, including 196 males and 242 females. Ultrasound bone densitometry was used to detect the bone mineral density of the human bone. Six SNPs of LPPR were screened for PCR amplification. Data were analyzed by SPSS 18.0. The construction of haploid was performed by PHASE1.0.

The bone density of the Mulao population gradually decreased with age, female decreased more significantly than males (P<0.05). The OP rate of men increased from 7.9% to 57.9%, while women increased from 17.6% to 76.4%. The normal rate decreased from 92.4% to 42.1% for men and from 22.1% to 23.6% for women.

Among the six LPPR SNPs, the distribution of rs1137100, rs2767485, and rs465555 in the normal and osteoporosis population was significantly different (P < 0.05). At locus rs1137100, AA may be the risk genotype of osteoporosis (OR = 5.287; 95% CI = 1.338–20.893; P = 0.022); whereas in locus rs2767485, the C allele has a higher risk of OP (OR = 3.284; 95% CI = 1.530–7.178; P = 0.002) than T, also in the rs465555 locus, the T allele has a higher risk of OP than the A allele (OR = 1.733; 95% CI = 1.214–2.475; P = 0.002).

The linkage disequilibrium test showed the effects of locus rs1137100, rs2767485, rs465555, are independent of each other.

The SNP loci of LEPR gene: rs1137100, rs2767485, rs465555 may be the susceptibility factors of osteoporosis in Guangxi Mulao population.

P1-CM6

Development of patient-derived PD-L1-expressing grade 2 non-

muscular invasive bladder cancer in NOG/SCID female mice

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Development of relevant models of human cancer is still challenging. To establish an experimental model of grade 2 non-muscular invasive PD-L1-expressing bladder cancer (NMIBC) fresh tumor tissue samples were removed from patients via cystoscopy with biopsy or tumor resection at National Research Medical Center of Radiology (Moscow). An informed consent to participate in the study was received from each patient. Tumor tissues were divided into three pieces under sterile conditions. One piece of each tissue specimen was immediately placed in particular medium without antibiotics and without fetal bovine serum for storing at 4˚C until engrafting. Another piece was cryopreserved for molecular biological examination, and the last piece was fixed in 10% formaldehyde for histological examination (HE). Before engraftment we selected samples of luminal, p53 and basal subtypes of newly diagnosed NMIBC, relapsed luminal and basal tumor (1 sample of each kind) by HE, clinical cases reviewing, and GATA3, KRT5/6 expression as well as PD-L1 expression level detection using immunohistochemistry (IHC). Only PD-L1 expressing tumors were accepted for further inoculation. 6-8 week NOG/SCID female mice (n=20 for each line), acceptors of patient-derived xenograft (PDX), assigned to the referred subtypes of bladder cancer first underwent 3.4 Gy irradiation and then were subjected to simultaneous transplantation of human lymphocytes (5×107 cells/mouse intraperitoneally) and PDX pieces subcutaneously. The piece for engraftment of each molecular subtype of the tumor was divided into small pieces and inoculated into the dorsal subcutis of a mouse. After PDX's mass expanded to over quadruple its size, the xenograft tumor was harvested and directly re-transplanted for expansion in later serial generations using the same procedure. After the tumor tissue was passaged five times and HE, IHC confirmed the PDX to be a growing human tumor expressing PD-L1, the PDX line of each subtype of bladder cancer was considered as ‘established’.

P1-CM7

Novel Approach to Inhibit Ca2+ Entry Through NMDA-receptor Ion Channel in Mix Hippocampal Cell Culture of Sprague Dawley Rats

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Development of promising approaches to brain injury treatment remains challenging due to complicity of the pathology and time limitations, during which effective treatment must be applied. LHT-4-18, novel Zn-containing compound of 2-aminoethansulfonic acid was developed and used as a substance (purity - 98,75%) to address neural Ca2+ overload during cerebral ischemia / hypoxia. We designed in vitro study to investigate an influence of Zn-containing compound LHT-4-18 on NMDA-receptor Ca2+-channel conductivity as a possible protective mechanism in ischemia-induced brain injury. All laboratory protocols were reviewed and approved by Sechenov University Ethic Committee, September 5, 2018, No. 9. In experiments in Sprague Dawley rat hippocampal cell culture using fluorescent imaging method we investigated how Zn-containing substance LHT-4-18 impacted intracellular calcium concentration. All the

experiments were performed with 10 DIV cultures. Cytosolic Ca2+ concentration was measured with a ratiometric fluorescent probe Fura-2. We registered single neuron Ca2+ signals and calculated their averaged values in one experiment, or mean values of suppression of these signals, obtained with 3 independent cultures. The error in determining the mean when measuring the amplitudes was 0.04. We found out that the substance caused an inhibitory effect and suppressed NMDA-receptor activity in concentration 10 μM and above. The effects are reversible or partially reversible and occurred as depression of neuronal Ca2+-signals amplitude in response to NMDA applications, as well as inhibition of Ca2+-pulses in response to magnesium exception (removal of magnesium block) from the cell environment. Thus, inhibitory effect of Zn-containing compound LHT-4-18 can be based on the ability of the substance to block Ca2+ ion channels of NMDA-receptors. The compound may be considered for further progress as promising anti-ischemic drug.

P1-CM9

The effect of a regeneration extract from the Mexican Axolotl on the HL60 leukaemia cell line

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Even though the mortality rates from malignant cancers have decreased, a lot still needs to be done in terms of improving the overall treatment regimens and eliminate or reduce the "the one size fits all" strategy that is currently the case.
To investigate the ability to cause terminal differentiation of cancer cells with an extract from the regenerating limbs of the salamander Ambystoma mexicanum. In axolotls, when a limb is amputated, the organism has the ability to regenerate the missing limb via wound. Since some cancers are caused by a block in differentiation, addition of a protein extract from the regenerating limb of axolotls could theoretically cause: activation of differentiation pathways without necessarily correcting the underlying insult that initiated the differentiation block; rectification of the initial defect causing the differentiation blockage; and/or cause epigenetic modifications thereby exposing transcription sites allowing access to other differentiation causing drugs like all-trans retinoic acid. To investigate the ability to cause terminal differentiation of cancer cells, an extract derived from the regenerating limbs of the axolotl (AXE) was tested on the HL60 leukaemia cell line. AXE was evaluated for its ability to induce granulocytic differentiation using the Nitro blue tetrazolium test (NBT), and trypan blue was used to determine the number of live and dead cells. HL-60 cells were also tested for cell surface antigens CD11b and CD14, cell cycle analysis, and degree of apoptosis. AXE exhibited a statistically significant differentiation effect on HL60 cells. HL60 cells exhibited granulocytic differentiation that was detected using the NBT test and CD11b surface marker. These data indicate that AXE merits further investigation to identify if any of the factors involved in regeneration can cause terminal differentiation of leukaemia cells.
The Faculty research Ethics Committee granted approval under Ref. No. FRECMDS_1819_002

P1-CM10

To study the protective effects of miR-26a on myocardial infarction-induced injury

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Myocardial infarction (MI) remains the leading cause of morbidity and mortality worldwide, carrying an enormous medical and social burden. Apoptosis and fibrosis after MI were often observed in MI-induced cardiac injury. A number of recent reports have addressed the role of miRNA in this injury. However, the changes of

miRNAs expression and their potential roles in MI-induced apoptosis and fibrosis are still poorly understood. The aim of this study was to investigate miR-26a expression profile in MI and to elucidate its role in MI-induced cardiac apoptosis and fibrosis. In our clinical study, we found that miRNA microarray and real-time polymerase chain reaction were used to examine miR-26a expression in ST-Elevation Myocardial Infarction (STEMI) and non-coronary heart disease (non-CHD) patients. The study was approved by the Ethics Committee of National Taiwan University Hospital (201310056RINC) and the written informed consent was obtained from all participants. In our animal experiments, miR-26a expression was also assessed in MI-treated mice. Functional analysis was performed by using miR-26a mimic. The procedures of animal experiments were conducted in accordance with the Animal Care and Use Committee of National Taiwan University. In the conclusion, miR-26a was downregulated in STEMI patients when compared with non-CHD patients. Down-regulation of miR-26a was closely correlated with the increased expression of creatine kinase, creatine kinase-MB and Troponin I. Cardiac tissues showed a significant increase of apoptosis and fibrosis after 1day and 14 days of MI, respectively. In addition, miR-26a was significantly reduced in MI-treated heart when compared with the sham group. MiR-26a overexpression effectively reduced apoptosis and apoptosis-related protein. These data demonstrate that miR-26a expression is an important factor that contributes to ischemia-induced apoptosis and fibrosis. MiR-26a may be served as a potential therapy for MI treatment.

P1-CM11

The relationship between the mesentery, gut and enteric nervous system during development – an immunohistochemistry approach

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Recent clarification of mesenteric anatomy has indicated that the intestines are enveloped in a continuous, rather than fragmented mesentery, as previously thought.This has prompted a need to re-examine its anatomical relations. Advances in understanding the development of the mesenteric tissues has highlighted its potential role as a facilitator of neural crest cell migration during enteric nervous system development.

Our aim is to describe the development of the mesentery, gut and enteric nervous system independently and subsequently determine how each of these components relates to the other during development. Of particular interest is clarifying the manner in which efferent and afferent autonomic fibres develop and communicate when innervating the gut. A histological and immunohistochemical approach has been employed to highlight nervous tissue and other components of rat embryonic tissue sections. Animal procedures were in accordance with Republic of Ireland Department of Health and Children license. Further immunohistochemical analysis of regional samples of rat gut at embryonic days 12, 14 and 16 will allow microscopic confirmation of the continuous mesenteric structure arising from its developmental framework. The objective is to advance this preliminary study of rat embryonic tissue to human embryonic tissue and ultimately describe it molecularly. This will address the paucity of information available on the development and anatomical course of nerves through the mesentery in the human.

An understanding of the developmental innervation of the mesentery and gut has implications for advancing knowledge of normal anatomy as well as relevant pathological states such as Hirschsprung Disease.

P1-CM12

Association of Smoking and level of Expression of Vascular Endothelial Growth Factor (VEGF)

gene with Oral Squamous cell Carcinoma

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Oral squamous cell carcinoma(OSCC) is the commonest cancer among Sri Lankan males. Smoking is an identified risk factor for the development of OSCC. Tumor growth and metastasis depend on angiogenesis triggered by chemical signals from tumor cells. The most important angiogenic factor is Vascular endothelial growth factor (VEGF). The study aimed to determine the correlation of clinicopathological factors and VEGF gene expression in OSCC patients attending the Apeksha Hospital, Sri Lanka. Ethical clearance was obtained from the Ethics Review Committee(Ref-29/16), Faculty of Medical Sciences. Forty histologically confirmed primary OSCC patients and 40 age-gender matched controls were included in the study. VEGF gene expression in venous blood was determined using quantitative real-time PCR using the TaqMan chemistry. The experiments were done in duplicate keeping the GAPDH gene as the housekeeping gene. Gene expression was determined using the Livak method and relative quantification(RQ) was calculated. The smoking habits were assessed using interviewer based questionnaire. Percentage70(28/40) of cases were ever-smokers; among them,[35%(14/40) had used >2 packs of cigarettes/day. Among the ever smoking cases 30% (12/40)] had a smoking history of >20 years. The mean relative quantification(RQ) of VEGF gene expression among patients were found to be high(2.14±0.834) and showed 2.21 fold increase compared to the control group(0.0.92±0.58)(P<0.001). Forty patients comprised of carcinoma of tongue(28/40), Buccal mucosa(9/40), other oral mucosal sites(3/40). The majority [46.42%(13/28)] OSCC of tongue had RQ ranging from 2.0-3.0 while 55.55%(5/9) patient with OSCC in buccal mucosa had the RQ between 1-1.5. Histologically poorly differentiated cancers(4/40) had the RQ >2. Moderately differentiated OSCC(8/40) had 2 equal distribution peaks of 1.0-1.5(5/8) and 2.0-2.5(3/8). Majority of the patients 77.5%(31/40) were in T1-T2 TNM stage. Among them, 23.10%(9/31) had RQ of 1.0-1.5, while 33.3%(3/9) of T3-T4 stage had RQ of 2.5-3.0. Findings suggested a positive correlation between VEGF mRNA expression and histological differentiation.

P1-CM13

Identifying novel osteoarthritis (OA) biomarkers via anatomical discrepancies between OA-predisposed and OA-protected murine knee joints.

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Biological events preceding osteoarthritis (OA) onset are poorly understood, and scoring systems have low predictive power for disease onset or progression. Human OA research is limited by late employment and coarse resolution of clinical imaging. Surgical joint destabilisation is used to model OA, but such injury-induced disease subtypes are reduced in their relevance to spontaneous human age-related OA. Knee-joint comparison of two mouse models aids this dilemma. The Str/ort mouse strain develops OA spontaneously and predictably with age, the condition severity of which is environmentally modifiable, as observed in humans. CBA mice are a genetically similar parental strain which instead model healthy joint ageing.

The purpose of this study was to quantify anatomical variation between Str/ort and CBA knee joints, with particular focus on the calcified cartilage (CC) layer. Our primary hypothesis is

that congenital CC anatomical variation is an unacknowledged early OA risk factor with a mechanical role in disease aetiology. We predicted OA-predisposed Str/ort knees to show enlarged, heterogeneously oriented and aspherical mineralised CC lacunae relative to the OA-protected CBA strain, and that these features would precede the articular cartilage demise characteristic of OA. We anticipated this biomarker would be evident in OA-predisposed knees before disease, offering predictive power lacking in clinical practice.

Mice were killed at 10, 20 and 40 weeks (age intervals represent Str/ort pre-, early- and late-stage OA) via CO_2 asphyxiation. Hindlimbs were removed and frozen at -20°C until use. 0.6µm high-resolution tomographic scans were obtained from the I13-2 pink beam at the Diamond Light Source, Harwell. Image analysis of anatomical features was performed at the Royal Veterinary College. All procedures were carried out in accordance with the Animals (Scientific Procedures) Act 1986, and were approved by the Royal Veterinary College Ethical Review Committee and the United Kingdom Government Home Office under special project licence.

P1-CM15

Cyclic changes of the organization of striated rootlets and the localization of α-tubulin N-acetyltransferase (ATAT1) in fibroblastic KD cells.

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The mother centriole can mature into a basal body to form a primary cilium at the G1/G0 phase of the cell cycle. The axonemal microtubules are selectively acetylated to provide the structural stability of the cilia. Striated rootlets, consisting of rootletin, emanate from the basal bodies/centrioles. C-Nap1 binds to rootletin directory. This protein complex enables the interaction between basal body/centriole and rootlet. We investigated the cyclic changes of the organization of striated rootlets and the localization of ATAT1 in fibroblastic KD cells.

Primary cilia were seen in KD cells, but disassembled as KD cells re-entered the cell cycle. During the migration of the replicated centrosomes toward the spindle pole, striated rootlets were separated from the centrioles, fragmented into small pieces, and finally lost in the mitotic cells. We found that C-Nap1 was localized to the fragmented rootlets at the early stage of mitosis. It suggests that rootletin has been interacting with C-Nap1 after detachment of the rootlets from the centrioles. The depletion of rootletin by siRNA had no effect on the frequency of primary cilia, but it induced the disassembly of C-Nap1 on basal bodies/centrioles. Rootletin-deficient cells became round in shape, indicating a decline in cell-adhesion ability.

ATAT1 localized to centrioles and basal bodies in the interphase, and to the nuclei as clusters in the G1/G2 phase. In the telophase, ATAT1 co-localized with chromatids and spindle poles and ultimately migrated to the daughter nucleus, newly synthesized centrioles, and midbody. The nucleolus is a core region of ribosomal RNA transcription, and the midbody is associated with the severing and depolymerizing of microtubules in the stembody. These findings suggest multiple functions of ATAT1, which could include the acetylation of microtubules, RNA transcription activity, the severing of microtubules, and the completion of cytokinesis.

P1-CM16

Alopecia in Aifm1 Hq/Y “Harlequin” mutant mice is caused by layer-specific downregulation of structural hair genes

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The X-chromosomal gene apoptosis inducing factor (Aifm1) encodes a mitochondrial protein associated with the respiratory chain and caspase-independent cell death. In hemizygous

male “Harlequin” mutants (Aifm1 Hq/Y) the expression of Aifm1 in many tissues is reduced to about 20% of wild-type levels due to a proviral insertion. While the impact of the Aifm1 Hq mutation on cell death and metabolism has been investigated in several organ systems, we studied the alopecia in these mice.

Immunoblot analyses showed that the expression level of AIFM1 in Aifm1 Hq/Y skin was reduced to the same degree as in the brain. Using immunohistochemistry, AIFM1 protein was detected in the basal layer of the epidermis, the sebaceous gland, in the matrix and precortical cells of the hair follicle bulb of anagen hair follicles in wild-type mice.

While the growing hair shaft in Aifm1 Hq/Y mice appeared normal up to postnatal day 8, histological examinations demonstrated kinks in subapical segments of the hair shaft around day 9 which later folded up in the pilary canal, causing the baldness of the mutants. Ultrastructural examination of the mutant hair shaft revealed that the hair cortex was not fully keratinised, while the hair cuticle was. Northern blot analyses and in situ hybridisations on skin samples obtained between P8 and P12 showed that hair keratins and keratin-associated proteins exclusively expressed in the hair cortex were downregulated in Aifm1 Hq/Y mice, while the expression of regulatory genes Foxn1 and Msx2 and genes encoding intermediate filament protein specific to other layers of the hair follicle was unaltered.

Our results demonstrate that the fragility of the hair shaft and hence the alopecia in Aifm1 Hq/Y mice is caused by the specific downregulation of genes encoding structural proteins in the hair cortex, while genes from other layers are not affected.

P1-CM17

SNPs polymorphisms and their genotypes of adiponectin gene distribution in osteoporosis and normal population

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Osteoporosis (OP) is a systemic bone disease characterized by low bone mass. OP is affected by multiple factors. Adiponectin may be associated with OP. This study aims to explore the relationship between adiponectin and OP. Our study was approved by the Ethical Committee of Youjiang medical university for Nationalities. 623 people from Guangxi Zhuang people were selected. The bone mineral density (BMD) was measured by ultrasonic bone densitometer. Five single nucleotide polymorphism (SNPs) of Adiponectin gene (rs1063539, rs12495941, rs266729, rs3774261, rs710445) were selected for PCR amplification. Data were analyzed by SPSS 18.0. The construction of haploid was performed by PHASE1.0 software. Our data revealed a significant difference in BMD between the 45-year-old age group and the 70-year-old age group ($P<0.01$). In all over 55 years age groups, men's BMD was significantly higher women ($P < 0.05$). Proportion of normal BMD decreased with age from 65.2% to 40% in male, while from 50% to 0% in female. On the other hand, OP rate increased from 15.4% to 30% in male, while from 7.7% to 82% in female. The frequency of CG genotype of rs1063539 was higher in the case group (48.2%) than in the control group (36.7%), while the frequency of GG genotype in the case group (39.6%) was lower than that in the control group (51.9%). The CG gene is a protective genotype of bone density (OR=0.582, 95% CI: 0.411-0.824), while C is inversely associated with the occurrence of osteoporosis (OR=0.744, 95% CI: 0.582-0.951). The frequency of rs3774261 AG genotype of adiponectin gene in the case group was higher than control group (55.4%).The linkage disequilibrium test found no linkage between the two sites of rs1063539 and rs3774261, suggesting their effects on osteoporosis were independent.

P1-CM18

The genetic structure of Hmong-Mien speaking Miao people in

southwest China inferred from genome-wide SNP genotyping

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The Hmong-Mien speaking Miao people are one of the 56 officially recognized ethnic groups living primarily in southern China's mountain area of Guizhou, Yunnan, Sichuan, Hubei, Hunan, Guangxi, Guangdong and Hainan. Their scattered distribution provides a unique opportunity to study the genetic and linguistic evolution. Here we collected 67 Miao samples from Longlin, Huanjiang, Longsheng, Xilin, Rongshui, Sanjiang, and Ziyuan in Guangxi. We genotyped the samples with more than half million genome-wide single nucleotide polymorphisms (SNPs). We used Principal Component Analysis (PCA), ADMIXTURE analysis, f statistics, qpWave and qpAdm to infer the population genetic structure and admixture. Our data revealed that Miao people are genetically similar to the Hmong-Mien and Tai-Kadai speaking populations in southern China, which is consistent with their linguistic classification and geographic distribution. We also observed genetic substructure in Miao people. The Miao people in northwest Guangxi show a close affinity with Hmong-Mien speaking Miao and She populations in other regions of China. However, the Miao people in northeast Guangxi share more alleles with Tai-Kadai speaking Zhuang people than with Hmong-Mien speaking Miao and She populations in other regions of China, suggesting there was gene flow between Miao and their surrounding populations after they migrated to Guangxi.

P1-CM19

Role of the acrosome membrane protein Equatorin in fertilization

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Equatorin (Eqtn) is a widely distributed acrosomal protein in mammalian sperm including human. We previously reported that a part of Eqtn relocates onto the plasma membrane of the equatorial segment of sperm head during the acrosome reaction, where the sperm-egg fusion occurs, and that an anti-Eqtn antibody MN9 inhibited fertilization in vitro and in vivo. Here, we established a mouse mutant, the Equatorin-knockout (Eqtn-/-) mouse model and found that Eqtn-/- males reduced fertility due to sperm-egg adhesion failure. Eqtn-/- females were fertile, but Eqtn-/- males reduced fertility. Eqtn-/- males were healthy and showed normal sexual behaviors. Eqtn-/- sperm were normal in morphology and motility, showed a normal migration pattern in the oviduct and normal acrosome reaction progression. They possessed major fertilization-related proteins and the capacity of receiving CD9 from oocytes. Nevertheless, the two-cell formation rate and the pronucleus formation rate were significantly lower in Eqtn-/-. The sperm accumulated in the perivitelline space were more frequently found in Eqtn-/- males. The gamete binding assay using activated sperm and zona-free oocyte demonstrated that the number of sperm attached to oocytes was significantly lower in Eqtn-/- males. Our data suggested that Eqtn and Izumo1 play different role in the process from sperm-egg adhesion to fusion. This study was approved by the Biomedical Research Ethics Committee of the Graduate School of Medicine, Chiba University. All animal experiments were conducted according to the guidelines for the care and use of laboratory animals of Chiba University.

P1-CM20

Aging-related CEACAM1 signaling promotes vascular dysfunction

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Aging is an independent risk factor for cardiovascular diseases and therefore of particular interest for the prevention of cardiovascular events. However, the mechanisms underlying vascular aging are not well-understood. Since CEACAM1 is crucially involved in vascular homeostasis, we sought to identify the role of CEACAM1 in vascular aging.

Using human internal thoracic artery and murine aorta, we show that CEACAM1 is upregulated in the course of vascular aging. Further analyses demonstrated that TNF-α is CEACAM1-dependently upregulated in the aging vasculature. Vice versa, TNF-α induces CEACAM1 expression. This results in a feed-forward loop in the aging vasculature that maintains a chronic pro-inflammatory milieu. Furthermore, we demonstrate that age-associated vascular alterations, i.e. increased oxidative stress and vascular fibrosis due to increased medial collagen deposition crucially depend on the presence of CEACAM1. Additionally, age-dependent upregulation of vascular CEACAM1 expression contributes to endothelial barrier impairment, putatively via increased VEGF/VEGFR-2 signaling. Consequently, aging-related upregulation of vascular CEACAM1 expression results in endothelial dysfunction that may promote atherosclerotic plaque formation in the presence of additional risk factors.

Our data suggest that CEACAM1 might represent an attractive target in order to delay physiological aging and thereby the transition to vascular disorders like atherosclerosis.

P1-CM21

Identification of estrogen producing cells in the human stomach

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It had been reported that gastric parietal cells have aromatase and synthesize estrogen in rats and goats. The gastric estrogen is secreted into the portal vein, then almost all the estrogen bind to hepatocytes. In humans, there had been reported that aromatase, estrogen, progesterone, and its receptors were expressed in gastric cancer cells. However, there has been no report of investigation of aromatase expressions in normal gastric tissues. In this study, we identified aromatase positive cells in the human stomach using some markers of gastric mucosa. Biopsy tissues were collected from the stomach in 15 human subjects (9 men, 7 women, average age 48.8 ± 10.7 years old). Specimens without aberrations like autolysis and intestinal metaplasia in the tissues were used for materials. We demonstrated fluorescence double staining with primary antibodies to aromatase, H/K-ATPase β-subunit for parietal cells, Pepsinogen 1 for chief cells, Gastric mucin 6 for mucous neck cells, Gastric mucin 5 AC for surface mucous cells, Chromogranin A for endocrine cells, and 17β-estradiol. Aromatase was expressed in the gastric glands in all the specimens. Furthermore, the aromatase colocalized with H/K-ATPase β-subunit and 17β-estradiol, and did not with the other markers. In humans, it therefore is clarified that the parietal cells produce estrogen irrespective of age or sex as well as in rats and goats. Since a large amount of aromatase exists in human gastric mucosa, it is suggested that the gastric estrogen induces the estrogenic symptoms such as gynecomastia and metrorrhagia in addition to estrogen hypometabolism attributed to the liver dysfunctions or disorders. (COI: NO)

P1-CM22

The increased number of mast cells in epicardial adipose tissue is associated with coronary artery disease

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Inflammation of adipose tissue can affect its metabolic activity associated with the pathogenesis of coronary artery disease (CAD). Mast cells represent an important component of the innate defense system. In our work, we quantified mast cell counts in epicardial adipose tissue (EAT), subcutaneous adipose tissue (SAT), and atrial myocardium (AM) in patients undergoing open heart surgery with various metabolic diseases.

Bioptic samples of EAT (n = 44), SAT (n = 42) and AM (n = 17) were fixed by 4% paraformaldehyde and embedded into paraffin. All participants signed a written informed consent prior to the enrollment into the study and the study was approved by Human Ethics Review Board. An anti-mast cell tryptase antibody was used for immunohistochemical detection and quantification of mast cells. The expression of CD117 and chymase was also demonstrated immunohistochemically.

In EAT of patients with CAD, a higher number of mast cells was found compared to patients without CAD (3.7 ± 2.6 vs. 2.1 ± 1.2 cells / mm2). Higher number of mast cells in EAT of patients with obesity and type 2 diabetes mellitus (DM2T) was not statistically significant. In SAT and AM there was no difference in the number of mast cells in patients with obesity and without obesity, neither in patients with CAD or without CAD nor in patients with DM2T and without DM2T. Mast cells in SAT, EAT and AM expressed CD117 and chymase.

An increased number of mast cells in EAT patients with CAD may indicate the specific role of these inflammatory cells in relation to epicardial adipose tissue and coronary arteries affected by atherosclerosis.

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P1-CM23

Three streams for the mechanism of hair graying

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Hair graying is an obvious sign of human aging. Although graying has been investigated extensively, the mechanism remains unclear. Here, we reviewed previous studies on the mechanism of graying and seek to offer some new insights. The traditional view is that hair graying is caused by exhaustion of the pigmentary potential of the melanocytes of hair bulbs. Melanocyte dysfunction may be attributable to the effects of toxic reactive oxygen species (ROS) on melanocyte nuclei and mitochondria. A recent study suggests that bulge melanocyte stem cells (MSCs) are the key cells in play. Graying may be caused by defective MSC self-maintenance, not by any deficiency in bulbar melanocytes. Our previous study suggested that graying may be principally attributable to active hair growth. Active hair growth may produce oxidative or genotoxic stress in hair bulge. These internal stress may cause eventually depletion of MSC in the hair follicles. Taken together, hair graying may be caused by MSC depletion by genotoxic stress in the hair bulge. Hair graying may also be sometimes caused by dysfunction of the melanocytes by oxidative stress in the hair bulb. In addition, hair graying may be attributable to MSC depletion by active hair growth.

P1-CM25

The rate of synaptic degeneration after injury is developmentally regulated and is an intrinsic property of the motor unit sub-type

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Axon and synaptic degeneration occurs following nerve injury and during disease. Nerve injury results in rapid fragmentation of the distal axon and loss of synaptic terminals, in a process known as Wallerian degeneration (WD). In adult, wild-type mice, tibial nerve lesion results in a loss of motor nerve terminals within the deep lumbrical (DL) muscles within 24 hours. Interestingly, the rate of WD in mice aged 2 weeks and under is much slower, with rates progressively increasing until adult rates are achieved at around P24. It remains unclear whether this developmental delay is unique to DL preparations. Here, we utilise an ex vivo model of nerve injury to characterise this critical transitional period between P15-P24 in mouse cranial and abdominal nerve/muscle preparations. Firstly, we found that developmental delays in WD were present in all preparations analysed. For example, at P15, the auricularis superior remained 80.7±5.66% (mean±SEM) innervated. As expected, the rate of degeneration increased with age, with 59.68±7.54% innervation remaining at P18, 5.26±4.87% at P21 and 3.98±1.79% at P24. We also found that rates of degeneration were non-uniform, with some preparations exhibiting higher rates of WD. For example, abductor auris longus was significantly more denervated, with only 30±5.11% innervation remaining at P15. Interestingly, we found that rates of WD in abdominal preparations were uniformly delayed across all time points. At P24, transversus abdominis and triangularis sterni remained over 87% innervated, contrasting the cranial preparations. Thus, developmental, selective vulnerability may be a feature of WD, with rate-determining factors being intrinsic to different motor unit sub-types. We also provide evidence for a lack of association with patterns of muscle-type vulnerability described previously in animal models of motor neuron disease. Animal procedures were performed in accordance with UK Home Office guidelines. This work is funded by the Anatomical Society studentship programme and MNDA.

P1-CM26

The endocrinal signal transduction systems in the mouse corticotroph cell line AtT20 cells are finely tuned by the α-tubulin acetylation of microtubules

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Microtubules play important roles for intracellular transport of secretory granules in endocrine cells. Its functions are regulated by various post-translational modifications of tubulins. The lysine residue at the 40th amino acid sequence of α-tubulin faces the liminal side of microtubule and is acetylated by α-tubulin N-acetyltransferase 1 (ATAT1). We have previously reported that adrenalectomy upregulates ATAT1 expression and the levels of acetylated microtubules in adrenocorticotropin (ACTH)-producing corticotrophs of pituitary. However, the regulatory mechanism of ATAT1 expression and the role of α-tubulin acetylation in corticotrophs is unclear. Here, we analyzed the effects of corticotrophin-releasing hormone (CRH) or dexamethasone (Dex), a synthetic glucocorticoid, on ATAT1 expression in mouse corticotroph cell line AtT20/D16-F2 (AtT20). Real-time PCR experiments showed that ATAT1 expression was increased by CRH and decreased by Dex. We next examined the effect of ATAT1 knockdown on the expression of ACTH-related genes (transcription factors, processing enzymes, and receptors) in AtT20 cells and found that the knockdown of ATAT1 reduced the α-tubulin acetylation and increased the expression of ACTH-related genes. We also found that the knockdown of ATAT1 inhibited the reduction of expression of proopiomelanocortin (POMC), a precursor of ACTH, by Dex and decreased the Dex-induced nuclear translocation of glucocorticoid receptor (GR). On the other hand,

ATAT1 overexpression by the transfection of plasmid DNA leaded additionally significant increase in α-tubulin acetylation and the Dex-induced nuclear translocation of GR. These results suggest that the acetylated microtubules function as the rail-line for the transportation of GR into the nucleus. We conclude that ATAT1 finely tunes the cellular responses of corticotrophs to hormonal stimulation through an intracellular feedback circuit. Although the living animals are not used in this study, all animal experiments of our former investigations were conducted in compliance with the Guide for Care and Use of Laboratory Animals established by Teikyo University.

P1-CM27

Effects of oral β-carotene supplementation on cytochrome P450 2E1 expression of C57BL/6 mice exposed to ethanol consumption

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Induction of cytochrome P450 2E1 (CYP2E1), in low and moderate ethanol doses, appears to be one of the central pathways by which ethanol generates a state of oxidative stress. The aim was to investigate a possible antioxidant role of oral β-carotene supplementation through the gene expression of CYP2E1 in mice exposed previously to ethanol consumption. Eighteen male mice were used, divided into six groups: Control (C), Low-dose alcohol (LA), Moderate-dose alcohol (MA), β-carotene (B), Low-dose alcohol+β-carotene (LA+B) and Moderate-dose alcohol+β-carotene (MA+B). At the end of experimental phase, the animals were euthanized and hepatic tissue was obtained from each animal. RNA was extracted and RNA integrity was quantified and evaluated. Ct values of CYP2E1 were averaged, and the relative expression level of each RNA was calculated using the 2^-(delta-delta Ct) method. This project was approved by the Scientific Ethics Committee of the Universidad de La Frontera (Nº043/2016). Higher values of CYP2E1 fold change were found in LA+B groups, while MA+B group presented the lowest level. The groups exposed to ß-carotene showed decreased gene expression of CYP2E1. There were significant differences between the LA (0.931±0.283 fold) and LA+B (0.555±0.169 fold) groups. Likewise, MA (0.610±0.185 fold) and MA+B (0.435±0.132 fold) groups showed differences. Previous studies suggest the ethanol feeding produced a fold increase in CYP2E1 protein in mice. While, other studies described an antioxidant effect of ß-carotene supported by a decreased oxidative stress, indicated by a lower CYP2E1 activity in rats exposed to ethanol intake. In this sense, in our study found lower CYP2E1 activity in mice exposed to ethanol intake and ß-carotene supplementation. Thus our results suggest that the degree of hepatic damage produced by different doses of alcohol can be prevented. However, the amount of alcohol consumed, exposure time and regulatory mechanisms of alcoholic liver disease should be considered.

P1-CM28

Bisphenol A promotes cell proliferation and hypertrophy in peripheral mononuclear cells and hippocampal glial cells by differentially modulating ERα expression

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Bisphenol A (BPA) is a synthetic xenoestrogen diffused worldwide as one of the main plastic components. Humans are chronically exposed to low doses of BPA which poses a potential health risk. Several studies investigated the reproductive toxicity of BPA, however studies on other systems are still scarce and contrasting. Because the immune system can be modulated by estrogens, endocrine disruptors like BPA could influence immune cell activity leading to cancer, autoimmune disease and neurological disorders. To investigate the effects of BPA on immune cells, cell proliferation, cell cycle progression and DNA damage were evaluated in Phytoemagglutinin-stimulated peripheral blood mononuclear cells (PBMCs) from three healthy volunteers. Cells were grown in the presence or absence of BPA concentrations (from 5 to 100 nM) nearly the daily limits fixed by the Authorities. Results indicated that BPA promoted cell growth and caused an accumulation of cells in S-phase of the cell cycle. Furthermore, BPA induced chromosome aberrations enhancing ERα expression and the phosphorylation of γH2AX, a DNA damage marker. To investigate whether similar effects could be produced by BPA in glial cells known to exert immunosurveillance within the central nervous system, we evaluated glia number and morphology in 17PND female rats obtained from pregnant females who received BPA (0.1 mg/L in drinking water) soon after coupling and all over the lactation. At sacrifice, animals were anesthetized by overdose of Tanax (0.1 ml intrapulmonary) and brains removed and processed. Experimental protocols were approved by the Ethical Committees (authorization number 45/2014-PR 17/11/2014). The results showed that within the hippocampus, BPA increased the number of astrocytes, most of which with a hypertrophic morphology, and reduced ERα expression in neurons. Overall these results suggest that BPA is able to affect the immunosurveillance functions exhibiting opposite effects on ERα expression at peripheral and central level.

P1-CM30

Improving our understanding of bone marrow anatomy in healthy and osteoarthritic patients using flow cytometric analysis to identify white, beige and brown adipocytes

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Bone marrow adipose tissue (BMAT) constitutes 10% of all adipose tissue found in the human body. There are three known types of adipocyte: white, beige and brown. BMAT has previously been described as a heterogeneous mix of adipocytes, however, this has not been quantified. BMAT in osteoarthritic (OA) patients typically has an increased number of adipocytes. This study aimed to identify and quantify the types of adipocyte present in normal and pathological BMAT.

Human joint samples from 24 patients (12 control, 12 OA) were obtained with informed consent from patients undergoing joint surgery at University Hospitals of Morecambe Bay NHS Trust. North of Scotland NHS Research Ethics Committee approved this research. Samples were prepared for routine histological analysis and flow cytometry.

Flow cytometric analysis identified adipocytes types using adiponectin (Acrp30), uncoupling protein 1 (UCP1) and myogenic factor 5 (Myf5) as markers of white, beige and brown adipocytes. The data analysis showed an approximate 9:1 ratio of white to beige adipocytes found within BMAT, with only trace amounts of brown adipocytes identified. ANOVA analysis to account for disease, age and biological sex demonstrated no significant difference in the adipocytes present between control and OA samples. However, male sex and ageing were shown to be significant factors for an increase in beige adipocytes.

These results were corroborated with immunohistochemistry of paraffin cut sections to validate the flow cytometric analysis. The anatomical location of the adipocyte type was also recorded. The histological study showed that beige adipocytes were found closer to the bone surface than the centre of the bone marrow adipose tissue. This research gives a quantitative method of identifying different types of bone marrow adipocytes. Understanding changes in the anatomical composition of BMAT may prove important in understanding the progression of OA.

P1-CM32

Role of Tumor Susceptibility Gene 101 (TSG101) gene in stretched rat podocytes

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Increased mechanical stress in glomerular hypertension is considered to damage podocytes. We have recently identified Tumor Susceptibility Gene 101 (TSG101) as a stretch-induced candidate gene among others by cDNA array analysis to mechanically stressed podocytes. TSG101, which is part of the ESCRT-I complex, is thought to be involved in multivesicular body (MVB) formation. The purpose of this study was to identify genes that are differentially regulated by mechanical stress in podocytes. TSG101 up-regulation in stretched podocytes and glomeruli isolated from desoxycorticosterone acetate (DOCA) salt-treated rats (2.5 wk treatment) and localization of TSG101 were examined by using RT-PCR and immunofluorescence procedures. MVBs were de¬tected by transmission electron microscopy in foot pro¬cesses and in larger processes of podocytes in untreated rats. As to rats, experiments were performed on eight adult male Wistar rats (500 g) in accordance with national and local animal protection guidelines and all procedures used in this research were reviewed and approved by University of Heidelberg. By cyclic mechanical stress, TSG101 mRNA is strongly up-regulated in conditionally immortalized mouse podocytes but differentiation of podocytes does not affect TSG101 mRNA levels. TSG101 immunofluorescence is distributed in a vesicular pattern in podocytes, the staining intensity being enhanced by mechanical stress. Glomerular TSG101 mRNA levels are elevated in DOCA/salt treated rats(a model of glomerular hypertension) and an increased number of MVBs is observed by electron microscopy in podocyte processes.
The present study provides the first evidence that elevated mechanical stress up-regulates TSG101 in podocytes, suggesting that glomerular hypertension enhances sorting of cell surface proteins and their ligands into the degradative pathway in conditionally immortalized mouse podocytes.

P1-CM34

Novel soursop compound (sf-1603) induce apoptosis by interfering inhibitors apoptosis proteins expression in hepg2 cell line culture. Drug discovery study for liver cancer targeted therapy

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Hepatocellular carcinoma (HCC) is the sixth most common cancer in the world and the third most common cause of cancer death. The incidence of HCC is associated with an increase inhibitors apoptosis protein (IAP) expression which linked to tumor progression as well as resistance to treatment. Therapy strategies based on molecular targets through signal transmission intervention and regulation of apoptosis offering new hope for more effective therapeutic choices. Soursop plant is believed to have a strong

anticancer activity. It was hypothesized that active compound in the soursop leaves will be able to induce apoptosis by interfering IAP gene expression. The objectives of the study are to explore the role of novel compound (sf-1603) isolated from soursop leave againts IAP expression in order to find molecular target for HCC therapy.

This study was in vitro experimental study with complete randomized design to assess soursop active compound (SF-1603) effects on mRNA IAP expression in apoptosis induction on HepG2 cell line culture. Both control and treatment groups were treated by SF-1603 with dosage of 0,5xIC50, IC50 and 2xIC50. Observations were assessed in hours 0, 24, 48, and 72. Measurement of mRNA expression was done with real time PCR and apoptosis detection by using TUNEL method. This study has obtained ethical approval from Medical Research Ethics Committee Medical Faculty Padjadjaran University No.988/UN6.C2.1.2/KEPK/PN.

The results showed that IAP optimum expressions to initiate apoptosis were achieved with IC50 dose in less than observation hour 24. There was strong correlations between IAP expression with apoptosis level (r=0,723). This evidence indicates that administration of SF-1603 compound suppress IAP expression lead to apoptosis of cancer cells.

It was concluded that soursop leave novel active compound (SF-1603) is a powerful anticancer that affect IAP expression in apoptosis induction on HepG2 cell line culture as molecular target in HCC therapy.

P1-CM35

Scarce Occurrence of Calcification in Human Sinoatrial Nodal Arteries in Old Age

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To elucidate age-related changes of the sinoatrial nodal artery (SANA), the authors investigated age-related changes of elements in the SANA by direct chemical analysis. In addition, the effects of different arterial origins, arterial sizes, and genders on element accumulation were investigated in the SANA. Fifty-nine formalin-fixed adult Thai hearts were dissected and the following three types of the SANA were found: (1) single SANA arising from the right coronary artery (RCA); (2) single SANA arising from the proximal segment of the left circumflex artery (LCX); (3) dual SANA arising from both the RCA and the LCX. For element analysis, both 41 single SANAs arising from the RCA and the LCX and 18 larger branches of dual SANA were used. After the arteries were incinerated with nitric acid and perchloric acid, element contents were determined by inductively coupled plasma-atomic emission spectrometry. It was found that seven element contents such as Ca, P, S, Mg, Zn, Fe, and Na did not change significantly in SANAs with aging. Regarding the relationships among seven elements in SANAs, extremely significant direct correlations ($p<0.0001$) were found among P, S, Mg, and Fe contents with one exception. However, no significant correlations were found between Ca and either P or Mg contents in the SANAs. To elucidate whether calcification occurred in the SANAs in old age, both the mass ratios of Ca/P and Mg/Ca were estimated in the SANAs. The mass ratio of Ca/P increased progressively in the SANAs with Ca increase, being not constant. The mass ratio of Mg/Ca decreased gradually in the SANAs with Ca increase, but the average mass ratio of Mg/Ca was very high, being 49.4±16.5%. These results indicated that calcification scarcely occurred in the SANAs in old age. This study was approved by Research Ethics Committee of Faculty of Medicine, Chiang Mai University.

P1-CM36

EQUATORIN/SPESP1-double knockout mice reduce male fertility with aberrant behavior of IZUMO1

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A number of sperm proteins are involved in the processes from gamete adhesion to fusion, but the underlying mechanism is unclear. Here, we show that a mouse mutant, the EQUATORIN/SPESP1-double knockout (Eqtn/Spesp1-/- or -DKO) male mice significantly reduced fertility. The average pups produced by EQTN/SPESP1-DKO males was 3.0, significantly lower compared with those produced by EQTN-KO males (6.3) and by SPESP1-KO males (7.8). Immunofluorescence signals with anti-IZUMO1 antibody showed that a sperm-egg fusion related protein IZUMO1 was aberrantly distributed on the sperm head of EQTN/SPESP1-DKO sperm after the acrosome reaction, compared to the distribution found on the wild-type sperm head. IZUMO1 translocated to the equatorial segment a bit earlier than EQUATORIN at the very initial stage of the acrosome reaction, and was widely distributed on both equatorial segment and postacrosome region. IZUMO1 was rather readily detached from the acrosome-reacted sperm. By contrast, EQUATORIN emerged on the the equatorial segment soon after IZUMO1 reached the equatorial segment, and then stayed on the equatorial segment even after the acrosome reaction. Sperm that reached perivitelline space of eggs recovered from the wild-type females after mating with EQTN/SPESP1-DKO males had unusual granular or clusters of IZUMO1 on the sperm head. The reduced fertility of the EQTN-KO males was rescued by a transgenic mouse, Eqtn-/--Tg (Eqtn) males; the distribution of EQUATORIN was normally present in the acrosome cap, and both 2-cell formation rate and the number of pups produced were completely restored by natural mating. Based on these findings, we present a hypotheical model about the behavior and relationship of IZUMO1, SPESP1 and EQUATORIN. This study was approved by the Biomedical Research Ethics Committee of the Graduate School of Medicine, Chiba University.

P1-CM37

Sensibility of the Fasciae to Sex Hormone Levels

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It is now recognized that women suffer from myofascial pains to a greater extent than men, and that the muscular fasciae can respond to hormonal stimuli, thanks to the expression of sex hormones receptors, but how the fasciae can modify their structure under hormonal stimulation is not clear.

In this work we isolated fibroblasts from human fascia lata of a volunteer, females patient, 50 y, who was undergoing elective surgical procedures at the Orthopedic Clinic of Padova University. Ethical regulations regarding research conducted on human tissues were carefully followed (approval no. 3722/AO/16, by Institutional Ethics Review Board), after written informed consent was obtained from the donor. An immunocytochemical analysis of collagen-I, collagen-III and fibrillin was carried out on cultured fibroblasts after an in vitro treatment with different levels of sex hormones β-estradiol and/or relaxin-1, according to the different phases of a woman period (follicular, periovulatory, luteal, post-menopausal phases and pregnancy).

We have demonstrated for the first time that cells of fascia can modulate the production of the extracellular matrix according to the hormone levels, when treated with β-estradiol: collagen I goes down from 6% of positivity of the follicular phase to 1.9 in the periovulatory phase. But, when in the cell culture Relaxin-1 was added, the production of extracellular matrix decreased and it was maintained at the same level (1.7% of collagen I, both with follicular and periovulatory levels of hormones).

These results confirmed the antifibrotic function of Relaxin-1 by the ability to reduce matrix synthesis, and help to explain why women with hormonal dysfunctions may have myofascial pains by the dysregulation of extracellular matrix production.

P1-G1

Case report: Origin of the right vertebral artery from the common carotid artery associated with aberrant right subclavian artery in human

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The anomalous origin of the right vertebral artery from the common carotid artery is a rare arterial variation, with a reported incidence rate of 0.18%. It is typically an incidental finding on angiography, CT or post mortem examination.
The aim of this study is to report a case of anomalous origin of the right vertebral artery associated with and aberrant right subclavian artery. It was found on enhanced CT images of a 79-year-old patient admitted with acute ischemia of the upper right limb, presumedly from distal embolization from an axillary artery aneurysm. The CT was performed for surgical planning. The patient underwent surgical embolectomy, distal ligature of the aneurysm and carotid-axilar bypass. It was discharged after 5 days.
A multiplanar reconstruction was performed using Horos imaging processing software (the Horos project). The right vertebral artery originated from the right common carotid artery at 5,2cm from its origin in the aortic arch, lateral to the trachea and at the level of the forth thoracic vertebra. It entered the transverse formen at the fifth cervical vertebra. The subclavian artery originated from the aortic arch distal to the left subclavian artery (aberrant subclavian artery) and coursed behind the esophagus.
An extensive review of the literature found few similar case reports, most of them found during angiography. The origin of the right vertebral artery from the common carotid artery is almost invariably associated with an aberrant right subclavian artery. Only few reports emphasized on the aberrant entrance of the vertebral artery into the transverse foramen of the cervical spine.
Anatomical variations of the vertebral artery are important to recognize during surgical and endovascular procedures to avoid procedure-related complications. In our case it was crucial to avoid inducing vertebrobasilar ischemia before carotid clamping and arterial reconstruction.

P1-G2

Alcoholic extracts of buchholzia coriacia and occimum gratissimum alleviate lead acetate induced male reproductive system toxicity in wistar rats

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Buchholzia coriacea(wonderful kola) and Ocimum gratissimum (Scent leaf) are nuts and herbs believed to enhance fertility. Infertility is on the increase in Nigeria and poses a big social problem. The aim of this work was to determine the efficacy of wonderful kola and scent leaf alcoholic extracts supplementation in lead acetate induced male reproductive system toxicity. Thirty (30) albino Wistar rats weighing 100g to 180g were divided into six groups of five rats each. Group one was normal control given distilled water; Group 2 was given 50mg/kg body weight(kgw) of lead acetate solution only; Group 3 was given 200mg/kgw of Buchholzia coriacea extract with 50mg/kgw of lead acetate solution; Group 4 was given 500mg/kgw of Ocimum gratissimum extract with 50mg/kgw of lead acetate solution; Group 5 was given 200mg/kgw of Bucholzia cariacea extract only and Group 6 was 500mg/kgw Ocimum gratissimum extract only. Ethical clearance was obtained from the appropriate committee in the Faculty of Basic Medical Sciences. Administration of extracts was done orally with orogastric tube once a day for 28 days. Animals were sacrificed humanely using Di-ethyl ether in a chamber. The testes were removed and processed for Haematoxylin and Eosin stains. Spermatozoa extracted from the cauda epididymis were used for sperm analysis using World Health Organisation method. Serum

testosterone levels were assayed using an enzyme linked immunosorbent assay kit. Results (mean±SEM) showed that lead acetate destroyed testes, significantly, reduced sperm motility (%) 73.44± 0.44 (control); 68.24± 0.42(toxic group); 72.42± 7.21;76.22±7.27 (Extract given) at $P < 0.05$ significant level.Testosterone levels (mMol/L)1.65±0.34(control); 0.91±0.21 (toxic group); 1.50 ± 0.29 ; 1.34 ± 0.14 (Extracts administration). Extracts of Buchlozia and Ocimum ameliorated toxic effects. Their actions are attributed to the phytochemicals present particularly the flavonoids and phenols. In conclusion consumption of extracts of Bucholzia coriacea and Ocimum gratissimum may enhance male reproductive functions.

P1-G4

A rare case of the left brachiocephalic vein running behind the ascending aorta in a cadaver, and potential complications arising

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The left brachiocephalic vein (LBCV) is formed by a union of each corresponding internal jugular vein (IJV) and subclavian vein (SCV). The LBCV usually runs anterior to three arteries; the brachiocephalic artery (BCA), the left common carotid artery (LCCA) and the left subclavian artery (LSCA). We report a rare variation of the LBCV running behind the ascending aorta. During routine dissection in the Department of Anatomy, we recognized a rare variation in a 66-years old Japanese female cadaver who had died of a heart failure. Furthermore, we observed several other interesting variants, including a variation in the origin vessel of the LCCA, the coalescence of two pulmonary veins in root of the left lung and patent foramen ovale. The LBCV is formed from the anastomosis between the left and right anterior cardinal veins. After the caudal portion of the left anterior cardial vein degenerates, the LBCV is formed. Generally the anastomosis is made abdominal portion of ascending aorta. It is logical to assume that the LBCV ran behind the ascending aorta because there was an obstacle in anastomosis formation at the abdominal portion. Where such a variation is present, there is a possibility that such a variation of the LBCV may be mistaken for the pulmonary artery. Therefore appreciation of these variations are important during various surgical and diagnostic procedures involving the upper chest. In this study, the methods were carried out in accordance with the 1964 Declaration of Helsinki, and the cadavers were legally donated for the research by the Teiyko University School of medicine at Tokyo in Japan. Informed consent was obtained from the family.

P1-G7

Age changes of renal sizes and renal interstitium in healthy women

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Ultrasound evaluation of renal parameters such as renal length, renal parenchymal thickness, renal cortical thickness and renal medullary pyramid thickness are important in analysis of patients with chronic renal diseases. Several studies have shown that reduction of these parameters gives an indication of the severity of chronic renal failure. However, at present, normal renal ultrasound parameters and variations due age, are not well established furthermore it is known from an anatomical perspective that there is a significant negative correlation between kidney size and age. Histologically, these the major age-related changes include nephrosclerosis, one of main features of which is interstitial fibrosis, but there is debate in the literature as to whether fibrosis of cortical and medullary interstitium happens with normal aging. The aim of the present study was to

analyse the effect of age on normal renal dimensions, as well as detect age-related morphological changes of renal interstitium. Ultrasound measurements of the right kidney from 34 women without renal diseases aged 36–55 (Group I) and aged 56-74 (Group II) were performed. The length (pole to pole), width and thickness of the kidney, as well as the size of its parenchyma were measured. Using histological, histochemical and morphometric methods the right kidneys of 10 healthy women obtained at autopsy (in the same age groups) were also investigated. Morphometric study of kidneys obtained at autopsy shows a significant increase of cortical and medullary interstitial fibrosis with age; medullary interstitial fibrosis in both age groups was significantly greater than cortical interstitial fibrosis. However, there was no statistically significant differences in renal size when comparing the two age groups. Ethical approval was obtained from the local ethical committee at Todua Research Institute of Clinical Medicine Institute. There is currently no legal framework for obtaining ethical approval for Anatomical Examination in Georgia.

P1-G8

Terminologia Neuroanatomica and its clinical and educational significance

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Based on recent advances in molecular neuroscience and brain imaging techniques, three sections of the Terminologia Anatomica (1998) that deal with the central nervous system, the peripheral nervous system and the sensory organs and pertinent parts of the Terminologia Histologica (2008) have been updated and merged to form a Terminologia Neuroanatomica. In 2016, the Federative International Programme on Anatomical Terminology accepted the Terminologia Neuroanatomica as its official terminology, thereby endorsing the scientific legitimacy of this version of anatomical terminology. The previous version of terminology had several limitations, including the fact that some sections were not updated for a long time and did not meet the needs of clinicians and teachers in practice. This situation offers an opportunity to take a closer look at these important modifications. Briefly, many new terms that are clinically important were added to the official list of anatomical terms, and a number of older names were reintroduced. This work aims to present the current status of the Terminologia Neuroanatomica against a background of clinical and educational needs that has stimulated its recent development. Based on our own experience of using Terminologia Anatomica in clinical and didactic practice, we provide new proposals that could be incorporated in the next version of anatomical terminology in the future.

P1-G9

The human fetal anatomy of the superficial fibular nerve

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The detailed fetal anatomy of the lateral compartment of the leg is not completely understood despite numerous studies. As this region is susceptible to injuries, detailed anatomical knowledge is indispensable for performing various surgical post-traumatic interventions. The superficial position of the superficial peroneal nerve (SPN) causes it to become particularly susceptible to trauma. The aim of this study is to evaluate SPN in the fetal period. A total of 207 miscarried foetuses (103 males) were analysed, from 113 to 222 days of foetal life. Classical preparation techniques were used to visualize SPN. Observations were documented by schematic drawings and photographs. The material came from the local collection. The age of the collection (1960-1990) and the influence of preservatives made it difficult to carry out accurate metric measurements; therefore, this study focuses on

the topography and distribution of SPN branches. The number of motor branches of SPN for long and short fibular muscles was evaluated. Two branches reached the long fibular muscle most frequently (left 56.05%; right 54.60%) and one branch reached the short fibular muscle (left 88.89%, right 90.82%). The statisticall analysis showed that there were no significant dimorphic and bilateral differences in this attribute. Based on the placement of the beginning of the nerve, a new typology was proposed—important from the surgical perspective. The criterion for the division was the head of the fibula. It was found that in both sexes, the most common is the division below the fibular head (65.2%). Moreover, the presence of accessory fibular nerve (NFA) was found in 30% of all the examined foetuses. The presented results are significant with regards to traumatology due to the high frequency of NFA and topography of SPN.

P1-G10

Abnormal Arrangement of Neurovascular Structures in Superior Mediastinum and Cervical Root in a Case of Situs Inversus Totalis

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The situs inversus totalis is a congenital condition in which the major visceral organs are reversed or mirrored from their normal positions. Although this abnormal condition is well known, the reports based on anatomic dissection of cadaver with this abnormality are very rare.
A 63-years-old male cadaver with situs inversus totalis was donated to Chungbuk national university of Korea. It was embalmed with common embalming solution and dissected with layer by layer. Then its abnormality of the neurovascular structures in the root of neck and the superior mediastinum regions were investigated. This study was performed in accordance with the principles outlined in the Declaration of Helsinki. Appropriate consent and approval were obtained from the families of the cadaver before the dissections were performed.
The anatomical position between the recurrent laryngeal nerve and the aortic arch was totally inverted. The left side recurrent laryngeal nerve was found in the inferior margin of the left side subclavian artery, whereas the right side recurrent laryngeal nerves was seen between the aortic arch and right side pulmonary artery.
Although the situs inversus totalis revealed a mirror image of the normal anatomic arrangement, preoperative anatomical evaluation is essential for prevention of intraoperative injuries and complications in patients with situs inversus totalis.

P1-G11

Are all perforating veins the same?

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In the leg some perforating veins (notoriously three veins on the medial side of the leg as described by Cockett) become insufficient while others don't. Could there be an underlying morphological difference among perforating veins?
Fifteen male cadaveric legs without visible abnormalities were dissected and yielded a total of 112 perforating veins. Permission for research followed the protocol of the Institution at the time of research. Of each perforating vein the epifascial tract, point of penetration through the fascia, location of the artery associated with each vein at the fascial opening, direction of the vein, length, diameter and the number, localization and orientation of valves were noted.
In 60% the epifascial tract contained at least one valve directing flow from superficial to deep. The identified perforating veins were categorized based on their branching pattern subfascial and communication with deep veins.
Type I had a single branch, type II a double branch and type III a double branch each into different deep veins. Subfascial bicuspid valves (up to 8 in number) were usually found within 5 mm from the fascial opening and the deep vein and when

more valves were present in a type II or III vein the location was almost similar in both branches. Valves in the deep veins showed no regular pattern. Other data collected showed no commonality among veins.
Two perforating veins were found without valves in one of their branches while one had a valve directing flow to the surface. Mono- and tricuspid valves were sometimes found in superficial and deep veins.
In our study the lowest Cockett vein lacked valves in the epifascial tract, the middle Cockett vein was generally short and single.
Anatomically no specific differences between perforating veins in healthy individuals were found to suggest a tendency to insufficiency.

P1-G12

The injection stress of pregnant female mice causes of the change of the 2:4 digit ratio in the offspring

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The 2:4 digit ratio (2:4DR) of vertebrate animals is the morphological marker for assessing of the level of the androgenization in the prenatal development. The validity using of the 2:4DR to assess of the level of prenatal androgens for postnatal physiological parameters and behavioral patterns has not yet been proven experimentally and it is questionable. It has been shown that similar effect of the prenatal androgenization can cause the handling, the immobilization and other type of the stress. The purpose of the study was to determine of the effect of injection stress of the pregnant female white laboratory mice on the definitive values of the 2:4DR of the offspring. All experiments were carried out in accordance with Directive of the Presidium and the European Parliament «On the protection of animals used for scientific research» (2010). The first group consists of animals which developed in conditions of physiological pregnancy. The second group consists of the offspring, whose mothers to the 12th day of the gestation intramuscularly 0.01 ml of the sterile olive oil was injected. The significant differences of the 2:4DR for male offspring among the groups were not obtained. The differences of the 2:4DR of the female offspring of intact animals were significant lower in the left hind limb and higer in the front right limb. Thus, the single intramuscularly injection of the oil to the pregnant mice in the critical phase of the morphogenesis of the limbs has a significant effect on the postnatal value of the 2:4DR of the offspring. This effect depends on the sex of the animal and on the side of the body on which the ratio was measured. The results require the revision of the widespread opinion it is the 2:4DR can serve as a reliable marker of the level of the prenatal androgenization.

P1-G13

Morphometric analysis of palpebral fissure in Caucasian population

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The orbital region as a key determinate in the facial attractiveness and health. Palpebral fissure is a natural body opening limited with eyelids. Anatomical characteristics of palpebral fissure vary according to age, sex, ethnicity, because of that knowledge of the dimensions of the palpebral fissure is important for reconstructive surgery and ophthalmology.
The aim of this study was morphometric analysis of the palpebral fissure and to determine the existence of differences between the right and left sides within the same gender.
Approval from the Institutional Ethics committee of Faculty of Medicine, University of Novi Sad was taken for the study. The study was conducted on 44 adult Caucasian subjects. The age range was 18 to 21. The condition for participation in the study was that the respondent has not a positive ophthalmic history and burden history of a

disease. Photographs were taken using "Nikon 3400D" professional camera and then measured using "Image J 1.48v" software. Data obtained was analyzed using "Windows Excel". Student's t-test was used at the $p<0.05$ level of significance.
The palpebral fissure height in male the right side is 9.76±1.69 mm, and on the left side 9.84±1.60 mm. The palpebral fissure height in female on the right side is 10.19±1.19 mm, and on the left side 10.11±1.30 mm. The measured parameter is not statistically significant (male $p=0.279$, female $p=0.269$), while statistical significance has been difference of outer canthi of the palpebral fissure on the right and left sides for the both genders (male $p=0.012$, female $p=0.002$).
Some parameters of the palpebral fissure have been show morphometric differences regarding the side within the same gender.

P1-G14

Case Study: A Possible Accessory Muscle of the Serratus Posterior Superior Muscle

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Anatomical variation is defined as the normal range of possibilities in the topography and morphology of body structures. In contrast, an anomaly is any structural or functional anatomical finding beyond the normal range of possibilities. This case study describes a muscular anomaly found in a 73-year old preserved Caucasian male.
A left-sided anomalous muscle was observed originating from the transverse process of the C1 (Atlas) vertebra and inserting onto the proximal attachment of the serratus posterior superior (SPS) at the C7 level.
It is thought that this anomaly is a result of early embryological development and it is hypothesize that the atypical neck muscle may reinforce the action of the SPS. Due to the rarity of this finding, a description of such a case is very infrequent in the literature. Reporting anatomical anomalies are important for medical literature and education.

P1-G15

Impact of overload due to obesity in the knee segment in Chilean School teachers

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Obesity and musculoskeletal disorders (MSD) are an important public health and economic problem worldwide. One of the most affected professionals with MSD are school teachers. Most of the studies focus on evaluating the anatomical regions of the neck / scapula and lumbar / gluteal, leaving aside other relevant axial axis such as the knee region. In Chile, MSD studies in school teachers are scarce. The present study aims to evaluate the impact of obesity on the prevalence of MSD in anatomical regions of the axial axis in Chilean school teachers. Cross-sectional study was conducted in rural and urban school teachers from the region of Valparaíso, Chile (n = 248), approved by the Ethics Committee of the PUCV. Obesity was evaluated by percentage of body fat by bio impedance. The Spanish version of the Nordic standardized questionnaire validated in Chile was used, which evaluates the prevalence of MSD in the previous 12 months. Sociodemographic aspects, obesity and area (urban and rural) were compared through logistic regression models. Of the total of school teachers analyzed, 179 (72.18%) were urban, 69.35% were female and 31.05% had an age equal to or greater than 45 years old. The prevalence of MSD in the neck / scapular, lumbar / gluteal and knee regions were 54.03%, 56.45%, and 41.84% respectively. Obesity was a risk factor for the knee region (OR = 2.30, 95% CI: 1.18-4.50) in young teachers (<45 years of age) independent from sex and area. The prevalence of MSD is high and the influence of obesity in the knee region

could be related to the overload that may be produced by the other regions of the axial axis, having a greater impact on teaching health in younger teachers. It is necessary to propose appropriate strategies to reduce MSD and obesity in school teachers.

P1-G17

Incisor is an important factor of the development of maxillary dental arch form

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The mesiodistal crown width of canine and bilateral intercanine distance have been reported as important factors of the development of maxillary dental arch form. However, there are not many studies evaluating other factors. Therefore, this study aimed to examine the factors of the development of maxillary dental arch form by statistical analyses.The present study conformed to the principles of the Declaration of Helsinki Ethical Principles for Medical Research (1964). The protocol (No. 050507: Morphological Analysis of dental arches) was approved by the Ethic Review Board of Osaka Dental University.396 paired maxillary and mandibular dental casts of young adult students (occlusal plane: 30 mm from the mandibular basal plane; distance between the maxillary basal planes in occlusal condition: 60 mm) were prepared. We selected 62 sets of maxillary dental arches with normal dentition and occlusion. We established 22 measurement points on the maxillary dental casts, and obtained data were analyzed using correlation and principal component analyses. Positive correlations were observed between bilateral inter-central incisor distance and bilateral inter-lateral incisor distance, mesiodistal crown width of central incisor, and arch length. Negative correlation was observed between bilateral inter-central incisor distance and anterior angle. Strong positive correlation was observed between bilateral inter-lateral incisor distance and bilateral intercanine distance. However, weak positive correlation was observed between bilateral inter-central incisor distance and bilateral intercanine distance. There was a strong positive correlation between mesiodistal crown width of central incisor and arch length. The original 22 sets of information were condensed into 4 components. Regarding component 1, principal component loading values for the bilateral inter-lateral incisor distance and mesiodistal crown width of central incisor, and arch length exceeded 0.7. The bilateral interincisor distance and incisor width influence maxillary dental arch form, especially arch length.

P1-G18

Predictors of Body Height Based on the Long Bone of the Limbs in Adult Males From Banjar Hulu Tribe

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Determining body height is an important aspect of forensic identification. Forensics identification is a part of medical forensic science that has an important role in the identification process, even if there are only body parts are found. This study aimed to predict body height based on the bone length of the limbs in adult males from Banjar Hulu Tribe (BHT). It is a population that inhabits the river valleys on the Meratus Mountain in South Kalimantan.This study used observational design with cross sectional approach. Sampling was conducted by purposive sampling with total subject of 35 men aged 21-50 years who fulfilled inclusion and exclusion criteria. This study has received ethical approval from the Medical Faculty of Lambung Mangkurat University ethics commission with No.743/KEPK-FK

UNLAM/EC/VII/2018. Data were analyzed using multiple linear regression with 12 independent variables, namely,the lengths of right upper arm (right UA), left upper arm (left UL), right forearm (right FA), left forearm (right FA),right hand (right HL), left hand (left HL), right upper leg (right UL), left upper leg (left UL), right lower leg (right LL), left lower leg (left LL), right foot (right FL), and left foot (left FL). The results of this study obtained regression equation for body height (BH) = 52.172 + (0.850 x right UL) + (2.081 x right HL) + (0.844 x right UA) with 93.9% accuracy in predicting body height of adult males from BHT. The conclusion of this study is the combination of right UL, right FL and right UA was able to predict the male height of the Banjar Hulu Tribe with very good accuracy (93.9 %).

P1-G19

Estimation of body height based on the bone length of the limbs in adult males from Dayak Ngaju tribe

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Ethnic identity is important in identification processconditions natural disastersor accidents occur, or for solving criminal cases and for recognizing unidentified bodies. This study aimed to estimate body height from the long bones of the limbs in adult males from Dayak Ngaju tribe. This tribe has the largest population in Central Kalimantan, with Dayak Ot Danum as their ancestor. The design used in this study was observational with cross-sectional approach. Samples were taken by purposive sampling technique with sample size of 35 managed 21 to 50 years who fulfilled the inclusion and exclusion criteria. This study has received ethical approval from the ULM FK ethics commission with a letter number, No.743/KEPK-FK UNLAM/EC/VII/2018. Data were analyzed using multiple linear regression with 12 independent variables, namely, the lengths of right upper arm (right UA), left upper arm (left UL), right forearm (right FA), left forearm (right FA), right hand (right HL), left hand (left HL), right upper leg (right UL), left upper leg (left UL), right lower leg (right LL), left lower leg (left LL), right foot (right FL), and left foot (left FL). The results showed that right UL and left FL could estimate body height with 86.2% accuracy, with regresson formula of Body Height = 75.877 + (0.903 x right UL) + (2.130 x left FL). Conclusion: The combination of right UL and left FL with the formula : 75.877 + (0.903 x right UL) + (2.130 x left UL) could estimate the male body height of the Dayak Ngaju Tribe with accuracy 86.2%.

P1-G20

Lymphoid formations of rectum in middle fetal period

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Studying the development of immune system of rectum helps understand the mechanisms of immune processes of organ. Objective: to study development of lymphoid formations of human rectum in middle fetal period.

The work was done on 27 preparations of rectum of human fetuses obtained in result of medical abortions in term of 21-28 weeks. Research was approved by Ethical Committee of University. According to Regulations of Health Ministry of Kazakhstan Republic, in cases of medical abortions for medical reasons an autopsy examination is carried out. Written informed consent was obtained for rectal tissue sampling during autopsy. No personal data was used for research.

Macropreparations of rectal mucosa by Hellman's method were made. Histological sections stained by hematoxylin-eosin were prepared.

Lymphocyte populations were studied by flow cytometry of suspension of intestinal cells.

In the rectal ampulla average number of lymphoid nodules per 0.25 cm2 was 4.3±0.97 (3.25-5.68), average size of the lymphoid nodules was 154.1±21.3 microns (122.4-195.3).

In the anal canal, lymphoid nodules were located mainly in the form of longitudinal chains between anal columns, average number of lymphoid nodules per 0.25 cm2 was 6.5±1.24 (4.15-9.37) and average diameter was 127.8±16.3 microns (102.5-149.1). Microscopically in proper mucous plate of the rectum lymphoid tissue was observed in form of lymphocytes accumulations around postcapillary venules, diffuse lymphoid infiltration, lymphoid prenodules, small lymphoid nodules and single interepithelial lymphocytes. Flow cytometry revealed the predominance of B-lymphocytes over T-lymphocytes and large number of immature lymphocytes. T-lymphocytes were represented by natural killers, cytotoxic cells and helper cells.

In middle fetal period, lymphoid tissue in the mucous membrane of rectum is represented by lymphoid formations of different maturity, which apparently indicates an active process of formation of immune system of organ. Topography of lymphoid formations of rectum is related to the location of the folds of mucous membrane.

P1-G21

The therapeutic effect of ellagic acid on hypertensive rat submandibular glands by phosphoproteomic analysis

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Ellagic acid (EA) is a natural phenolic compound and it has an extensive array of biological properties such as anti-hypertensive, antioxidant and anti-inflammatory activities. There is much evidence shows the change of salivary gland compositions in hypertensive condition. N-nitro-L-arginine methyl ester (L-NAME) is L-arginine analogs and widely uses to induce hypertension in the animal model. Protein phosphorylation plays a pivotal role in the control of many biological processes. An alteration of phosphorylation has been implicated in the disease pathogenesis such as cardiovascular disease, cancer, and oral diseases. However, no studies have investigated the therapeutic effects of EA on the phosphoproteins changed of the submandibular gland in the nitric oxide-deficit model. Therefore, the aim of this study is to investigate the therapeutic effect of EA on this salivary gland in L-NAME-induced hypertensive rats using phosphoproteomic methods. Male Sprague-Dawley rats received L-NAME (40 mg/kg/day) in drinking water for 3 weeks served as a hypertensive group whereas the therapeutic group was received L-NAME for 5 weeks and simultaneously received EA 15 mg/kg/day in the last 2 weeks. This study is approved by the Institutional Animal Ethics Committee of Khon Kaen University (AEKKU 50/2559). The Pierce Phosphoprotein Enrichment Kit was used to phosphorylate proteins from the submandibular tissues. The phosphoprotein samples were subjected to peptide fractionation using reversed-phase high-performance liquid chromatography and the gradient-eluted peptides were analyzed by an HCTultra PTM Discovery System. Phosphoproteins expression of submandibular glands in these three groups were investigated based on their biological interactions. Our study shows that there are 3 specific identified phosphoproteins in EA therapeutic group. These three proteins could be provided as the markers protein for the initial detection of reverse conditioning of submandibular glands after treated with EA.

P1-G22

Spatial distribution of erector spinae activity in people with low back pain during a dynamic lifting task

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Previous studies utilising high-density electromyography (HDEMG) have revealed subtle differences in the distribution of the superficial lumbar paraspinal muscle activity during both static and dynamic tasks in people with LBP. In the current study, we extend this work by uniquely evaluating the effect of chronic LBP on the spatial distribution of activity in both the thoracolumbar and lumbar erector spinae (ES) activity during a dynamic lifting task.
Ethical approval was granted from the University of Birmingham. Eleven LBP (5 men; 32.5±16.3years) and fourteen control (CON) participants (6 men; 27.7±11.4years) completed this study. HDEMG was acquired from the ES using four 64-channel (13x8) semi-disposable HDEMG grids (two grids bilaterally) placed over the lumbar and thoracolumbar ES. The spatial distribution of muscle activity was quantified as the centre of activity in the cranio-caudal axis (centroid); and the homogeny of signals (entropy). Reflective kinematic surface markers were placed over the trunk to track spinal kinematics. The dynamic task involved lifting a 5kg weighted box between two anterior shelves at knee and sternum height.
No differences in spinal kinematics were identified between groups ($P>0.05$) reflecting the standardised nature of the task. For both lifting and lowering movements, the distribution of ES activity was centred in a more cranial position ($P<0.05$). For the lifting phase, the mean LBP centroid was 82±5mm cranial to the base of the electrode grids whereas for the CON group the centroid was 78±8mm. For the lowering phase, the centroid was positioned 84±9mm in the cranial direction for the LBP group and 78±8mm for the CON. Additionally, LBP participants displayed a less even spatial distribution of ES activity throughout the task, reflected as systematically lower entropy ($p<0.05$).
These findings indicate that people with LBP engage more cranial regions of the ES during lifting, likely reflecting a less biomechanically favourable motor strategy.

P1-G23

Dissection of the Mesopancreas

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Pancreatic cancer has a high rate in population, representing a serious health problem. In the surgical treatment of this type of cancer it is important, besides the resection of the tumor, also the radical excision of the regional ganglionic groups and the propagation pathways of the metastasis. In this context, the mesopancreas gained an important surgical significance because it represents a migration route for cancerous cells to the celiac ganglia region. The mesopancreatic notion is debatable and it does not have a general recognition in the specialty literature. It generally concerns the tissues surrounding the origin of the superior mesenteric artery.
For our paper we resected the pancreas in a surgical manner. The head was separated from the body and the portal vein was highlighted and, after rigorous dissection, it was severed. Our posterior resection limit is represented by the premesenteric structures known as a part of the mesopancreas. Through dissection we demonstrated the continuity between the celiac ganglia branches and the superior mesenteric nervous plexus. From the premesenteric tissue we obtained microscope slides stained with hematoxylin and eosin on which we revealed lymphatic nodes, nervous fibers and nervous microganglia, as well as a venous plexus. The

specimens were digital photographed and edited without changing the scientific content.
We think that the structures described by us as the mesopancreas could represent a metastasis pathway for the pancreatic tumorous cells.
The dissections were obtained in the laboratory of the anatomy discipline where the ethical conducts are regulated and fall under the University of Medicine jurisdiction. In Romania the manipulation of cadavers is regulated by the law no 104/2003 which does not require special ethical conditions to accomplish dissections and to use the dissection images.

P1-G24

Variation of the foramen in the middle cranial fossa

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The greater wing of the sphenoid houses three consistent foramina; the foramen ovale, spinosum and rotundum, and variable foramina such as the foramen of Versalius. These foramina allow passage of neurovascular structures and knowledge of normal variations in location and size of these foramina is crucial in diagnosis and surgical treatment of conditions affecting the middle cranial fossa (e.g. trigeminal neuralgia). The incidence, anatomical morphology, morphometry, as well as the intra and extracranial location of the foramen ovale, spinosum, rotundum and Vesalius was investigated in 37 dry human skulls. Sex determination was conducted and measurements made using Vernier and spring calipers. Thirteen probable-female, 12 probable-male and 2 male skulls were categorised; the remaining 10 skulls where undetermined.
There were no significant differences in the position of the foramen to the sagittal midline or anterior skull between sides or genders. The foramen of Vesalius was found in 51% of sides, with the left (57%) being most frequent, although bilateral incidence was common. The foramen Vesalius (when present) was the smallest, most medial, and variable in diameter. The foramen spinosum was the most consistent in diameter. The foramen ovale and spinosum had the closest relative distance. The foramen ovale was most commonly oval (81.08%) in morphology, but significantly longer and thinner on the right-side of the skull. In addition, this study illustrated that the relative intracranial distances between the foramen spinosum, ovale and Vesalius were greater than their corresponding extracranial distances.
Asymmetries between sides are rare, and most commonly linked to embryological development, but could also signify pathology. Overall findings of this study vary when compared with published literature, most likely reflecting potential differences between populations in the samples being studied. An appreciation of the relative position and potential variations of the foramen in the middle cranial fossa is important in surgical procedures.
No ethical approval was required for this study.

P1-G25

Aterial Variations of the Celiac Trunk and Superior Mesenteric Artery in a Case of Situs Inversus Totalis

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The situs inversus totalis is a rare anatomical variation that mirror image of normal thoracic and abdominal organs. However, the reports based on cadaveric dissection for this abnormality is very rare.
This study represents the detailed description about abnormality of celiac trunk and superior mesenteric artery in a 63-years-old male cadaver with situs inversus totalis. This study was performed in accordance with the principles outlined in the Declaration of Helsinki. Appropriate consent and approval were obtained from the families of the cadaver before the dissections were performed.
The celiac truck divided into three major branches [right gastric (RGA), splenic (SA), and common hepatic artery (CHA)]. The CHA traveled to the left

side and the SA traveled to right. The RGA traveled to upper right portion of the lesser curvature of stomach. The CHA divided into the proper hepatic (PHA) and the gastroduodenal artery (GDA). The left gastric artery, left and right hepatic arteries arose from the PHA. The cystic artery arose from the left hepatic artery. The GDA divided into the anterior and posterior superior pancreaticoduodenal arteries. The dorsal pancreatic artery directly arose from the celiac trunk and traveled to behind of pancreas. Then it was anastomosed to the anterior superior pancreaticoduodenal artery. The superior mesenteric artery was located right to the superior mesenteric vein, and behind to the splenic vein.

Although the situs inversus totalis has simple mirror transposition of visceral organs, the abnormality of vascular structures are very complicate. When performing endoscopic hepatopancreaticobiliary surgery in patients with situs inversus totalis, these information on vascular variations related to celiac trunk and superior mesenteric artery may be useful.

P1-G26

Knowledge and attitudes towards genetic testing among public at a selected setting in Sri Lanka

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Knowledge and attitudes are likely to be important determinants for acceptance and utilization of genetic testing that has far-reaching benefits on human health and disease. This study explored the knowledge and attitudes towards genetic testing among first consented 100 patients attending the Family Practice Centre, University of Sri Jayewardenepura, utilizing an interviewer administered questionnaire.

Ethical approval was sought from the Ethics Review Committee, University of Sri Jayewardenepura, Sri Lanka–Ref07/18.

There were 46 males and 54 females. Majority (88%) had completed grade-10 education or beyond. Half of the participants were not aware about genetic testing for cancer risk. Only 36% knew that genetic testing utilizes blood samples. Of the total, 33% thought genetic testing can cause physically incurable side-effects while 34% did not know about. However, most participants were aware that genetic testing is useful in screening for genetic diseases before marriage (74%) and foetus of pregnant women with family genetic disease history (66%), in identifying paternity (86%) and sexual assault culprits (86%). Participants reported mixed attitudes. Many (67%) did not think that genetic testing lead to stigmatization of the person if diagnosed positive, however, thought (75%) that it can make life stressful. Eighty percent of participants did not want or were not certain that they would consent to do a genetic test to assess genetic disease risk. One fourth had a family cancer history even so there was no association observed with their knowledge regarding genetic testing.

The findings show a deficiency in knowledge and imbalance in attitudes towards some aspects of genetic testing despite relatively high educational status in the study population and in contrast to most European studies. Significant improvement in genetic literacy through public awareness programs and routine health-care practice is imperative to ensure informed decision making by the public in Sri Lanka regarding genetic testing.

P1-G27

Appraising Beauty of Sabah Indigenous people, Northern Borneo

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The face is a unique structure acknowledging a person to possess recognizable facial features. Human perception translates those features into a universal term “beauty”. In defining the beauty of individuals, differing perspectives may be applied. Having perfect physical appearance and attractiveness is related to self-confidence in current era. Attractive faces are said to have ideal facial proportions based on the divine or golden proportions of 1.618. The aim of this study was to appraise the facial proportion of some indigenous people residing in Northern Borneo to highlight their locally well-known facial beauty. Among the northern district of Borneo Island, this study selected Sabah, where several indigenous groups (over 32 groups) reside. Kadazan-Dusun and Bajau are the largest ethnic groups famous for the beautiful faces. Their beauty were assessed scientifically by using Neoclassical facial cannons developed by Farkas (1994). The facial characteristic of Bajau, Rungus (a descendent of Kadazan-Dusun) and Sungai (a minority ethnic group famous for their beauty) were compared using vertical and horizontal facial ratios. The results showed that the upper portion of the face for both sexes was significantly longer in Rungus and the nose width was significantly greater among Bajau. Naso-facial canon for Sungai females and orbital cannon for all studied ethnic people, regardless of gender, follows the Farkas principles. Other facial proportions of all three indigenous groups deviate from Farkas definition of facial beauty. The facial proportions of Sungai females followed at least two requirements of ideal beauty (as defined by Farkas) and would be classified more beautiful than the other two ethnic groups.

This study was approved by Research Ethics Committee, Faculty of Medicine, Universiti Malaysia, Sabah, Malaysia.

P1-G28

Variation of renal vein among Myanmar adults

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Knowledge of variations of renal vessels has grown in importance with the advancement of diagnostic and surgical procedures. As the incidence of renal vessels varied with different population, the objective of this study was to find out the variation of renal vein among Myanmar adults. It was a cross-sectional descriptive study. Among routine medico-legal post-mortem autopsy cases, 100 cases with morphologically normal kidneys were randomly selected and dissected after taking informed consent from one of the legally authorized representative person of the deceased. This study was done with the approval of Research Ethics Committee, University of Medicine 1, Yangon, Myanmar. Among 100 cases, variation of renal vein was observed in 13% (male 6%, female 7%) (unilateral 12%, bilateral 1%) (right 12%, left 2%). Presence of additional renal vein only on the right side was significantly higher than that on the left side (P=0.006). Out of 12% variation on the right side, 11% had single additional renal vein, 1% had three additional renal veins, all of them terminated into inferior vena cava. On the left side, among 2% variation, all had single additional renal vein, 1% terminated into left common iliac vein whereas the other 1% joined with left gonadal vein which eventually drained into the left main renal vein. Regarding the tributaries, right renal vein received suprarenal, gonadal, lumbar and accessory suprarenal vein in 12%, 13%, 3% and 3% respectively. Left renal vein received suprarenal and gonadal vein in every case and lumbar and accessory suprarenal vein in 37% and 11% respectively. This study confirms that variation of renal vein is not uncommon among Myanmar population. Awareness of these variations is important since vascular variations influences the criteria adopted for management by transplant surgeons and also imposes restrictions in surgical fields.

P1-G30

Fatty infiltration of the plantar aspect of the human foot is

largely variable in a baseline cohort with no known foot pathology: a cadaveric study

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Sarcopenia is a condition that affects the elderly, and those with type 2 diabetes mellitus (T2DM). It is associated to low muscle mass with an accompanied fatty infiltration (FI), a decrease in functional performance and muscular strength. Within the foot, the intrinsic muscles are important for supporting the longitudinal arches. However, muscular degeneration results in pain and reduced functioning, and an increased risk of mortality for T2DM amputees. FI in the feet has been noted using MRI and ultrasound, however to date, none have quantified the volume of FI using validated methods. The purpose of this study was to assess the volume of fat in the plantar muscular space of the foot in a baseline population without previously-known foot pathology.

Ethical approval was granted by the University of Otago for 12 cadaveric feet (mean age 82.6 (±) 12.2 years), to be sagittally sectioned into slices at an average thickness of 1.9mm, and subsequently photographed [Canon EOS 7D, Japan]. The overall intrinsic volume of the plantar muscular space and FI were calculated using OsiriX.

All specimens had FI of the plantar aspect of the foot, this included intramuscular, intermuscular and intra-ligamentous FI. Fat accounted for 26% (±) 7% (range 19 to 40%) of the total volume of the plantar muscular compartment of the foot. No significant difference was noted between the ratio of FI and the overall area with sex, nor side. No correlation was noted with age. A positive correlation was noted between volume of fat vs. the total area ($r=0.79$, $p=0.01$).

The individual differences in volume of fatty infiltration may result from nutritional, physical and hormonal elements. Our study suggests that fatty infiltration within the plantar foot muscular space may be a normal and highly variable phenomenon in the elderly.

P1-G31

Orbital bands (accessory extrinsic eye muscles) – report of two cases

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Background: Orbital bands also known as accessory extrinsic eye muscles may occur in various forms (various anatomical variants). Accessory rectus muscles have rarely been reported as muscular bands or slips originating from the common tendinous ring and inserting in atypical location. In this report we present two cases of the orbital bands connecting the superior and inferior rectus muscles.

Material and methods: 50 orbits taken from cadavers were dissected. After removal the orbital roof and lateral wall, the shape and anatomical variations of the extraocular muscles (i.e. the presence accessory muscular bands or atypical formation of the muscle) were assessed.

Results: In two cases we observed the presence of unusual muscular structure spanning vertically between superior and inferior rectus muscles. These rare anatomical findings were recognized as the accessory (supernumerary) rectus muscles. In the first case, the short tendon of the atypical muscle originated at the common tendinous ring and passed laterally to the optic nerve and the ophthalmic artery. In this case, two heads of the accessory muscle were inserted to the superior and inferior rectus, respectively. In the second case, the muscular band was spread vertically between superior and inferior rectus muscles with no additional origin.

Conclusions: Knowledge of muscular variations may be relevant during orbital imaging or surgical procedures.

Ethical approval Nr RNN/338/17/KE (21.11.2017).

P1-G33

HN242 ameliorates diabetic cardiomyopathy through reducing oxidative stress, inhibiting inflammation, and restoring mitochondria in mice

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Diabetic cardiomyopathy (DC), one of major complications, is a major cause of mortality in diabete patients, however, specific strategies for preventing or treating diabetic cardiomyopathy have not been clarified yet. The damages of heart in DM usually caused by the increase of the ROS, inflammation and apoptosis. Finding methods to reduce ROS and inflammation may protect cardiomyocytes from DM- induced damage and death. HN242 is a natural plant-extracted compound that increased the antioxidant ability in various tissues. This study aims to investigate the effects of HN242 on high fat diet (HFD)-induced diabetic cardiomyopathy.
First, in the in vivo model, C57BL/6 mice were fed with HFD for 10 weeks. The blood glucose reached the standard of type II DM. HN242 decreased the heart weight under HFD, reduced oxidative stress and elevated mitochondria content. In the following in vitro model, palmitic acid (PA) was used to mimic the effects of HFD on cardiomyocyte, H9c2 cells. The results demonstrated that HN242 reduced ROS by increasing the expression of anti-oxidant enzymes, including p-Nrf2, NQO1, and SOD1, inhibited inflammation by decreasing the expression of inflammation factor, including p-P65, TNFα and TGF-β, increased mitochondria content by increasing the expression of PGC1α and COXIV, reduced apoptosis by decreasing the expression of γH2A and c-caspase 3 in H9c2 cells. These data suggested that HN242 may ameliorate cardiac damages in diabetic mice by increasing the antioxidant ability and mitochondrial activity, decreasing inflammation, and protecting cells from death. HN242 has the potential as a novel therapeutic agent for both the prevention and the treatment of diabetic cardiomyopathy.
Animal process was followed the specifications of the Experimental Animal Center of the College of Medicine, National Taiwan University. Experiments were repeated at least 3 times. One way ANOVA and student t-test were used in the statistics. $P< 0.05$ was considered significant.

P1-G34

The Effect of Ciproxifan in Cerebral Ischemic Rats on Spleen Tissue

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Ischemia and reperfusion occur in some tissues or organs and may result in death. It causes permanent functional or structural damage. If ischemia-reperfusion occurs in a large body area, it is possible to see the damage not only in the tissues where the blood flow is stopped but also elsewhere in the body. Ciproxifan is highly potent histamine H3 inverse agonist/antagonist. Ciproxifan has been shown to cause vigilance and consideration in animal studies. We aimed to find out whether ciproxifan has an effect on spleen tissue in rats with ischemia-reperfusion injury.
On October 27, 2016, approval for the study was obtained from the Animal Experiments Local Ethics Committee of Eskisehir Osmangazi University with file number 556. 32 male and 32 female Wistar Albino rats were used in 8 groups. Control and Sham groups were given dimethyl sulfoxide for 7 days. After that, no surgical procedure was applied to the control group. Sham group was administered cerebral ischemia induced by common carotid artery technique for 15 minutes. 10 mg/kg ciproxifan were administered to the Low dose group and 30 mg/kg ciproxifan to the High dose group for 7 days/single dose. Both groups were administered

15 minutes of cerebral ischemia. Twenty-four hours following reperfusion, rats were sacrificed. Spleen sample was obtained from the rats.
Examination of the all rat spleen revealed that the spleen of control rats was observed in the normal histological structure. Sham group was observed parenchymal tissue damage and white pulp degeneration in rat spleen tissues. Low dose and high dose groups were observed parenchyma tissue damage in rat spleens. Low dose group was observed that red pulp and central arterial structures were close to normal with partial degeneration in the white pulp. High dose group was observed white pulp, red pulp and capsular structure in normal histological structure.

P1-G35

The Effect of Low and High Dose Ciproxifan on Brain Tissue in Ischemia-Reperfusion Model Treated Rats

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Cerebral ischemia-reperfusion injury is one of the most common and serious problems in the clinic. Brain tissue shows high sensitivity to ischemia-reperfusion injury resulting in neuronal damage and apoptosis. Ciproxifan caused cognitive enhancing effects during the relatively low use of the receptor and has been proposed as a potential treatment for the treatment of diseases such as Alzheimer's disease. The present study was designed to investigate the effect of ciproxifan on cerebral ischemia-reperfusion injury.
On October 27, 2016, approval for the animal study was obtained from the ethical committee with file number 556. A total of 64 Wistar albino rats (female and male) were obtained from Laboratory Animal Breeding and Experimental Research Center and the rats were divided randomly into control, sham, low dose and high dose groups (8 rats each).
For 7 days before the operation, the following treatments were given to the groups: either dimethyl sulfoxide (control and sham groups) or ciproxifan (10 mg/kg or 30 mg/kg). Following the treatment, rats were exposed to cerebral ischemia induced by common carotid artery technique for the duration of 15 minutes. Rats in each group were perfused after 24 hours of reperfusion and brain tissues were removed. After fixation, samples were obtained for routine histological tissue processing.
The cerebral tissue of control rats demonstrated the normal histological structure. Sham group demonstrated intense damage, dilated vascular structures and necrotic cell structures in the cortical area. Low dose group had a few dilated vascular structures and a small number of necrotic cells in the cortical area. High dose group illustrated neurons and glial cells in the cortical area similar to the control group. As a result, we have observed that ciproxifan has a protective effect on the cerebral tissue.

P1-G36

Novel insights into anatomy and functions of intertendinous connections of the human hand

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In the human hand, tendons can be connected by a thin transverse band of connective tissue, or also known as intertendinous connection. There are two intertendinous connections in the human hand including juncturae tendinum and Linburg–Comstock variation. Juncturae tendinum, or connexus intertendinei, is a connective tissue on

the dorsum of hand which adheres extensor digitorum tendons together. Juncturae tendinum helps to maintain spaces and distribute force during digital extension. We found that excision of juncturae tendinum resulted in reversible dislocation of the extensor digitorum tendons upon flexion of the metacarpophalangeal joint. In other words, juncturae tendinum may prevent extensor digitorum tendon dislocation during clenched fist, a novel function which has never been reported. Similarly, a variation known as Linburg–Comstock variation is the connection between flexor pollicis longus tendon and flexor digitorum profundus tendon to the index finger. This variation can be observed in the carpal tunnel in 25% of the population. Individuals with this variation can simultaneously flex the index while actively flexing the thumb. We have classified Linburg–Comstock variation into two types according to their histological appearance including fibrous and tendinous types. The fibrous type is characterised by a common synovial sheath covering the tendons of flexor pollicis longus and flexor digitorum profundus of the index, while the tendinous type is characterised by an additional tendon running from the flexor pollicis longus to the index. Anatomical terms including "vagina tendinis musculi flexoris pollicis longi et flexoris profundi indicis" and "musculus flexoris pollicis et indicis longus" are proposed to describe the fibrous type and tendinous type of Linburg–Comstock variation, respectively. Anatomical and functional knowledge of intertendinous connections in human hand is important for anatomists and surgeons operating in the region. This study was performed in accordance with the ethical standards of the institutional research ethics committee.

P1-G37

Positivity of Lawsonia intracellularis in seven regions of Costa Rica diagnosed by porcine fecal samples using Real time PCR

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Lawsonia intracellularis is an obligate intracellular, motile, curved, gram-negative bacterium that resides freely within the apical cytoplasm of infected intestinal enterocytes (Pusterla & Gebhart, 2013). Europe, Asia and North America have shown an individual prevalence of 24 to 47%. Herd prevalence for finishing pigs in other EU countries has been estimate to range between 88 and 100% (Pascu et al, 2015). Clinical signs: hypoproteinemia/hypoalbuminemia, thickened small intestinal loops on ultrasonographic evaluation and ruling out other causes of enteropathy and protein losses (Pusterla &Gebhart, 2013). The losses due to enteropathy are estimate by at least US $ 1.53 per affected animal (Moller, 2006). In Costa Rica, we reported two cases by histopathological findings: severe chronic active linfo-histio plasmocitic with eosinophils ileo-tiflitis with peyers patches hyperplasia. Real time qPCR confirmed L. intracellularis. The Cts for the samples were 24 and 20 cycles.

To determine the positivity of Lawsonia intracellularis in seven regions in Costa Rica by fecal samples using Real time PCR. In august 2018, 391 fecal samples were digitally extract from pigs between 12 to 22 weeks of age, a total of 18 farms from seven regions in Costa Rica and 22 samples per farm were taken. DNA extraction was performed in each sample by the commercial kit. Specific probe and primers used the 16S ribosomal DNA gene as a target. Real-time quantitative PCR was carry out and cycle thresholds (Cts) for each sample were determined. Positivity found in Costa Rica was 94,44% (17/18). Positivity results per region: San José 62.5% (25/40), Limón 48.24% (41/85), Alajuela 31.14% (39/111), Heredia 31.82% (7/22), Puntarenas 17.47% (11/63), Guanacaste 90.00% (18/20) y Cartago 46.00% (23/50). Lawsonia intracellularis is an endemic pathogen and real-time quantitative PCR represents a valuable technique for the specific diagnosis at a farm level.

P1-MA1

Morphological changes of ampulla region from mouse oviducts after repeated cycles of hyperstimulation

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Controlled ovarian hyperstimulation (COH) is routinely applied in assisted reproductive technologies (ARTs). However, repeated cycles of COH can induce complications in infertile patients, such as the ovarian hyperstimulation syndrome, or promote the growth of estrogen-sensitive tumors. The aim of this study was to investigate if repeated cycles of COH could induce morphological changes or even malignant-like transformations of the mouse oviductal epithelium. Ethical Committee for the animal care and use approved the experimental protocols. Swiss CD1 adult mice (2-3 months-old) were used. Animals were euthanized by cervical dislocation after an inhalant overdose of carbon dioxide (CO_2, 10-30%). All efforts were made to minimize animal suffering. COH was performed by an i.p. injection of 5 IU of PMSG (pregnant mare serum gonadotropin) (Folligon, Milano, Italy) and 5 IU of hCG (human chorionic gonadotropin) (Corulon, Milano, Italy), 48 h later. COH was repeated at one week intervals or 4 (4R) and 8 (8R) rounds; control (0R, Ctrl) and hyperstimulated oviducts were collected, fixed in glutaraldehyde 2.4%/PBS and processed for Light (LM) and Transmission Electron microscopy (TEM).

LM showed that the tunica mucosa of the ampulla lined with many folds projecting into the lumen; it consisted of both ciliated (CCs) and non-ciliated (NCs) cells with integral nuclei delimited by an intensely stained nuclear membrane. Cilia were detected only in the Ctrl group. TEM showed a good preservation of nuclei, SER tubules/networks and Golgi complexes in columnar cells, with the occasional presence of secondary lysosomes and multivesicular bodies in all groups. After 4R, it was found an interruption in the microvillar layer protruding into the lumen. Damaged mitochondria, identified by swollen appearance or disintegrated aspect with peripherally placed cristae, were found after 4R and 8R. The observed alterations, even if moderate, should be considered in the risk-assessment evaluation connected to repeated COH.

P1-MA2

Study the effect of Sofsbuvir (Sovaldi) on the Kidney of Adult Male Albino Rat

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Sofosbuvir (Sovaldi) is the backbone of many anti-HCV drug. The aim of this study is to demonstrate the effect of sofosbuvir on the renal cortex of adult male albino rat. Forty adult male albino rats were used in this experiment. Animals were divided in four equal groups. Group I (Control); each rat was given 0.18cm distilled water through an oral gavage daily for 4 weeks. Group II (Sovaldi treated): each albino rat was given 0.18cm distilled water containing 7.2 mg sofosbuvir through an oral gavage daily for 4 weeks. Group III (Recovery 1group); each albino rat was given 0.18cm distilled water containing 7.2 mg sofosbuvir through an oral gavage daily for 4 weeks then the rats were left for two weeks to clarify the effect of Sofsbuvir withdrawal. Group IV (Recovery 2 group): each albino rat was given 0.18cm distilled water containing 7.2 mg sofosbuvir through an oral gavage daily for 4 weeks then the rats were left for four weeks to clarify the effect of Sofsbuvir withdrawal.The experimental procedures were performed following the guidelines of the Laboratory

Animal Care and Use Regulations and approved by the Research Ethics Committee of the Faculty

of Medicine for Girls, Al-Azhar University, Egypt. At the end of the experiment, the rats were killed by deep inhalation anesthesia. Blood samples were taken to be used for measuring the kidney function and the kidneys were excised then prepared for light and electron microscopic studies. Sofosbuvir administration induced histological and biochemical insults in the renal cortex of albino rats. These changes were improved gradually after Sofsbuvir withdrawal but renal cortex didnot return to normal state after one month drug withdrawal.

Keywords: Sofosbuvir; renal cortex; male albino rats; renal function; recovery

P1-MA3

An ultrastructural investigation of the kidney following treatment with highly active antiretroviral therapy and Momordica charantia in non-diabetic and diabetic animals

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An ultrastructural perspective of the kidney treated with highly active antiretroviral therapy and Momordica charantia in non-diabetic and diabetic animals

With the introduction of highly active antiretroviral therapy (HAART) in the management of HIV/AIDS, the prognostic indication has shifted the pandemic into a manageable chronic condition. Despite this, there is still an unmet medical need on the severe side effects coupled with micro-structural perturbations especially in the kidney that have debilitated patients. This study reports ultrastructural changes in the kidney following HAART and adjuvant treatment with Momordica charantia in an experimental model.

Following ethical approval from the University of KwaZulu Natal animal research ethics committee (AREC) - ethics number AREC/033/016D, 78 adult male Sprague-Dawley rats were grouped into non-diabetic and diabetic and diabetes was induced by intraperitoneal injection of STZ (45 mg/kg body weight). Animals were treated with M. charantia and HAART regimen (triplavar) according to protocols. On day 70, the animals were euthanized with Halothane and kidney tissues were harvested and processed for transmission electron microscopy.

In the non-diabetic groups, TEM analyses showed thickening of the glomerular basement membrane (GBM) with fewer cytoplasmic autophagosomes and nuclear condensation marked in HAART-alone group compared to others. There were also mitochondrial distortion with podocyte membrane effacement and atrophied filtration slits observed. M. charantia-treated groups showed highly packed cytoplasm.

In the diabetic groups, nuclear membrane disruptions, basement membrane thickening with presence of dense bodies were seen in the diabetic control as well as HAART treated group. Podocyte membrane surfaces were irregular and sometimes wrinkled. Treatment with M. charantia alone and as adjuvant with HAART mitigated some of these structural observations thus suggesting a protective effect of M.

P1-MA5

Epiisopiloturine protects swiss mouse intestinal mucosa from morphological changes promoted by the aggression of 5-Fluorouracil

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Intestinal mucositis is a frequent complication in the treatment of cancer with the chemotherapeutic agent 5-fluorouracil (5-FU). So far there is still no effective treatment of this condition. Epiisopiloturine (EPI) is an alkaloid derived from Pilocarpus microphyllus Stapf ex Wardleworth has been reported as a potente

antinociceptive, anthelmintic, antioxidant, anti-inflammatory. The present study aimed to evaluate the effect of EPI on 5-fluorouracil-induced intestinal mucositis in Swiss mice (25–30g). The experimental protocol was approved by the Ethics Committee on Animal Use (9071050418). Initially the animals were divided into 6 groups (n = 6): DMSO group (vehicle solution of 2% at dimethyl sulfoxide), 5-FU group, EPI group (10mg/kg, i.p), L-NAME group (nitric oxide Inhibitor, 20 mg/kg i.p), L-NAME+ EPI group (L-NAME 20 mg/kg i.p + EPI 10 mg/kg i.p) and L-Arginine group (nitric oxide substrate, 300 mg/kg i.p). All animals except DMSO group received 5-FU at the concentration of 450mg/kg in the first day of experimental protocol. After euthanasia with overdose of anesthetic ketamine and xylazine the Jejunum portions were removed for evaluation of mucositis by histopathological and immunohistochemical analysis for iNOS (nitric oxide synthase). The 5-FU group demontred considerably reduction in villus height, crypt depth, and villus/crypt ratio compared to DMSO group ($p<0,05$). In contrast, the groups, EPI, L-NAME and the combination EPI+ L-NAME were able to reverse the morphological changes caused by chemotherapy ($p>0,05$). The group treated with L-arginine, on the other hand, did not present statistical difference of the 5-FU group. Moreover, the EPI group decreased the increase in iNOS expression caused by 5-FU ($p>0,05$). It is concluded that EPI protected the mucosa from morphological changes promoted by 5-Fluorouracil. In addition to decreasing the expression of the iNOS, demonstrating anti-inflammatory potential in intestinal mucositis.

P1-MA6

Expression of selected cytokeratins in the human placenta – the pilot study

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The human placenta (HP) maintains an ordered and layered division, the aim of which is to create a mother-fetus barrier and to conduct exchange between both organisms. Cytokeratins are an important element building the skeleton of epithelial cells. There are two classes of cytokeratins: first class acid, low weight; second class neutral or alkaline with higher weight. Research data confirm their presence in some structures of HP. The aim of the study was to evaluate the localization of expression of selected cytokeratins in normal HP. It is crucial to get to know it in order to conduct further comparative tests in HP pathologies. The study was carried out on 21 paraffin slices taken from 7 placenta (single pregnancy without pathologies terminated by caesarean section). The mean age of mothers was 31.62 years old and the mean weight of newborns was 3702 g. The work has the consent of the local bioethics commission. The samples were taken from several sites in HP according to a standard procedure. Immunohistochemical reactions were performed using commercial antibodies of cytokeratins: AE1/AE3 (CAE), HMW (HMW) and 5/6. The immunohistochemical method was used to localise positive cells for selected antibodies and to assess the anatomical localization of cells expressing selected proteins. No expression of 5/6 cytokeratins was demonstrated in HP. Strong expression within placental trophoblast in all types of villi was demonstrated (CAE). A very weak reaction within the stroma of stem villi has been observed(CEA). HMW antibodies were expressed only within the extravaginal trophoblast. The expression of cytokeratins in fibrinoid deposits and in the maternal part of the placenta was not demonstrated. The expression of cytokeratins shows a complex image of a mature placenta. The study provides a basis for comparative analysis of the expression of normal and pathological HP cytokeratins in order to simplify diagnostics.

P1-MA7

Feather microstructure of birds subject to illegal international traffic of wild animals through the use of scanning electron microscopy

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Microscopic bird feather structures have been used as source of data for bird identification since early the 20th century. Such data have also been applied for bird systematics and evolutionary history, with certain taxa exhibiting diagnostic suites in microscopic characters that aid on the delimitation of orders, families and even at species-level. Additional fields that benefit from feather microstructure include areas such as animal ecology, forensics, archeology, and criminalistics, with the latter mostly focused on the international traffic of wild animals. This study aimed to describe both macrostructure and the microstructure of bird feathers of eight species of brazilian Psittacidae that are commonly subject to illegal international trafficing. For each individual, five types of feather were qualitatively and quantitatively analyzed macroscopically (through the use of photos) and microscopically through the use of scanning electron microscopy (SEM). Our preliminary results show that feathers vary mostly in depth and total vane area (internal versus external), with Amazona aestiva, Ara ararauna and Brotogeris chiriri accounting for most of such variation. While parrots species exhibit round blotches limited to nodes, in macaws such blotches might expand to internodes. Putative diganostic fatures for parrots based on species herein analysed include long barbules with wide and pigmented nodes, and absence of vilosities in raquis cells. Even though the general microstructure is very similar in close-related species, such methodology is efficient in providing clear species identification for the Psittacidae species analyzed. Such data might provide valuable information for criminalistic purposes in Brazil, as well as on such bird's natural history. Further steps on our project will focus on the morphological evolution of such microstructures based on recent phylogenetic studies for the group. International, national, and/or institutional guidelines for the care and use of animals were followed.This study was undertaken with the permission of ICMBio number 63783-1.

P1-MA8

Comparison of Application of 3D Methods in Splenic Vascular Morphology

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This work was aimed to compare the usage yields of two microscopic 3D visual methods (laser scanning confocal microscopy /LSCM/ and scanning electron microscopy /SEM/) illustrating the image of spatial relationships in depicting the controversial parts of human splenic vascular bed. For the LSCM purposes, serial paraffin sections of human spleen infiltrated during fixation by the solution of 0,2% eosin in buffered formalin were investigated by LEICA SPE. Three-dimensional image of optical sections were subsequently performed by the software Ellipse Vidito and Cortona 3D viewer programme. For SEM purposes, samples were fixed by 3% glutaraldehyde buffered solution, rinsed in buffer, dehydrated up to 100% ethanol and were dried at critical point CO2. Finally they were sputter coated with 20 nm thick gold layer and examined with a SEM ZEISS EVO LS 15. LSCM provided sharp serial optic sections of arterial and venous walls,

capillaries and venous sinuses according to their distinct, brightly fluorescent, lamina basalis. Data served for the further 3D images. Vascular components needed to be marked manually for the software requirements and offered selective vascular 3D image, but with no depiction of surrounding cellular structures. This may be an advantage regarding to the image clarity within the spleen. SEM established an image of superficial structures with more cellular relations in details. Non of the SEM samples showed direct arterio-venous connection in comparison to LSCM. SEM limitation is the image depth, only superficial image is rendered. The application of three-dimensional visual methods to investigate such complicated vascular bed compartments as those in the human spleen are essential. Combination of both methods is the most usefull choice, because the collective usage may eliminate their individual limitations. No ethical approval was required, excess of splenic tissue served as a waste material. The work was supported by the grant KEGA 074UK-4/2019.

P1-MA10

The Role of Platelet Rich Plasma in the Microscopic Growth of Hair Follicles in Males with Androgenic Alopecia

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Various treatment modalities have been suggested for androgenic alopecia including medications such as minoxidil and finasteride. Platelet rich plasma injections are a recent advancement in hair restoration options. Studies have shown a change in gross presentation of hair loss in males. The present study was designed to investigate the effect of platelet rich plasma on the histological growth of hair follicles in individuals with male pattern hair loss.
After ethical approval and individual written informed consents from the participants a total of, 30 male patients with androgenic alopecia from stage IIa to stage IVa according to Norwood classification were included. Total 3 sessions of PRP treatment at Day0, Day30 and Day60 were administered to the patients scalp and two scalp punch biopsies of approximately 4mm2 were obtained before administration of PRP treatment at Day0 and Day60.The histological parameters (Epidermal thickness, Follicular count, follicular diameter, Terminal to Vellus ratio) were observed after H&E staining of scalp biopsy sample. Data were entered and analyzed using SPSS version 16.
A total 30 male patients with mean age of 33.07 ± 4.7 years (range: 20 – 42) were included in the analysis. The pre and post treatment response were more significant in stage II, III of androgenic alopecia for all four histological parameters as compared to the other stages of alopecia (95% confident interval). In post treatment analysis of histological parameters, a significant increase in follicular diameter after PRP treatment ($p<0.001$) was observed as compared to other parameters.
Platelet rich plasma is effective interventional therapy in hair restoration for patients of androgenic alopecia with significant improvement of hair counts as well as increased epidermal and follicle thickness.

P1-MA11

Regeneration of mineralised tissue following caudal autotomy in gekkotan lizards, Tarentola mauritanica and Tarentola annularis

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Following caudal autotomy, the gekkotan lizards Tarentola mauritanica and Tarentola annularis regenerate a new tail that is structurally different from the original, with new patterns of mineralisation in both the axial skeleton and in the arrangement of dermal mineralisations called osteoderms. Through the use of a range of imaging modalities a direct comparison was made between original and regenerated tails to investigate the process by which these tissues are ordered and to provide insight into how they develop. Both Micro Computed Tomography and electron microscopy also show that regenerated tails substitute vertebrae with a cartilage tube in which a soft, flexible middle layer is flanked externally and internally by mineralisation. CT scan images have also shown that the macroscopic arrangement of osteoderms shifts from a somite-consistent segmental distribution in original tails to a more evenly distributed arrangement. Histology has shown that osteoderms in both original and regenerated tails have a very different structure to osteoderms of other lizards, being significantly smaller and composed of clusters of smaller subunits, osteodermites. Electron microscopy has shown that osteodermites in the original tail have an organised outer layer and body containing few soft tissue pockets whereas regenerated osteodermites are structurally less organised and contain more soft tissue pockets. They appear composed of a mix of long and short fibres strewn together. Together, these findings show that while the patterning of osteoderms in the original tail appears to be controlled by the underlying somites, the mineralisations themselves develop independently. Nonetheless, the difference in microstructure between original and regenerated osteodermites demonstrates that there is more to learn about the processes controlling osteoderm formation.
(No ethical approval was required for this project)

P1-MA12

Immunohistochemical observation of Harderianized lacrimal glands in mice

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The Harderian gland (HG) is an exocrine gland located within the orbit of many mammals except primates. This gland excretes lipids to the ocular surface, and other than that, it produces prophyrins and melatonin. It has been reported that, in aged rats, exorbital lacrimal gland (EOL) partially became morphologically similar to HG. This phenomena is called “Harderianization”. Recently we have found that Harderianization also occurs in EOLs of aged mice. However, its histological characteristics have not been fully studied. In this study, we performed immunohistochemical staining using several antibodies to reveal the features of Harderianization of mouse EOL.This study was conducted according to the guidelines of the Institutional Review Board for the Care of Animal Subjects at the NDMC, Japan.
HGs and EOLs from 3 month- to 1.5 year-old male C57BL/6 mice were obtained and frozen and paraffin sections were made. The frozen sections were served for lipid staining using BODIPY 493/503. Paraffin sections were deparaffinized and incubated overnight with primary antibodies as follows; anti-α-smooth muscle actin (#65001, Progen, 1x), anti-type1 mucin (PA1-38207, Thermo Scientific, 100x) and anti-aquaporin 5 (#AQP51A, Alpha Diagnostic, 100x).
Lipid staining showed lipid particles in the cytoplasm of acinar cells and in the lumen in the Harderianized area in old mouse. In both normal HG and Harderianized parts of EOL, type 1 mucin was positive and aquaporin 5 was negative on the apical side of the acinar cell membrane, while type 1 mucin was negative and aquaporin 5 was positive in the terminal acini of the EOLs. α-smooth muscle actin-positive myoepithelial calls were detected in normal EOLs and HGs, while it was negative in the Harderianized parts of EOL.
These results indicate that Harderianized part of EOL is similar to HG not only morphologyically but also functionally, but still it differes from normal HG.

P1-MA13

The Histological Appearance of Kidney From Spraque-Dawley Rat With Vitamin B12 Restricted diet

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Deficiency of Vitamin B12 is still a health and nutritional problem in many countries. Several case reports explained an association between MMACHC gene abnormality and renal impairment. MMAHC is a gene responsible for cellular absorption of Vitamin B12.. This study aimed to explore the possible relationship between vitamin B12 restricted diet and kidney histological finding.
Experimental study was conducted at Laboratory of Department of Histology and Department of Biochemistry and has been approved by the Ethics Committee of Faculty of Medicine Universitas Indonesia. Eighteen male Sprague Dawley rats were divided into 3 groups; (1) control group were fed with standart AIN-93M for 12 weeks; (2) 1st treatment group (P1) were fed with cobalamin restricted AIN-93M for 4 weeks; and (3) 2nd treatment group (P2) were fed with cobalamin restricted AIN-93M for 12 weeks. Concentration of vitamin B12 in the plasma was measured with ELISA method. Histological structure of kidney was observed with Hematoxylin-Eosin and Masson Trichrome staining. Percentage of damage and fibrosis areas was measured with the image J software.
Concentration of vitamin B12 was decreased from 529.17±166.51pg/ml to 426.33±60.59pg/ml in P-1 and from 708.70± 124.35pg/ml to 519.16±84.96pg/ml in P-2 groups, while it was increased from 567,79±102.52pg/ml to 650.26±193.12pg/ml in control after 12 weeks. Histological findings showed irregularity of tubular structure, disruption of cellular integrity with unclear cellular border, disappeared of tubular lumen and infiltration of inflammatory cells in P1 and P2 groups. The tubular damage area was 12.97±2.42% in P1 and 24.86±3.60% in P2 groups. While It was 3.86±1.70% in control group. The fibrosis was found in tubular and interstitial area with 8.04±3.54% in P1 group and 16.49±2.82% in P2 groups, while It was 3.83±1.36% in control group.
As a conclusion, the dietary restriction of vitamin B12 showed the renal tubular damage, fibrosis and infiltration of inflammatory cells.

P1-MA15

The Thymic Tissue Side Effects Caused by Long-Term Administration of Dexamethasone and Medroxyprogesterone Acetate in Wistar Rats

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The purpose of our study was to determine the possible morphological side effects of thymic tissue after long-term administration of dexamethasone (Dex) and medroxyprosterone acetate (MPA). The experiment was performed with female Wistar rats divided in 5 groups, each one consisting of 12 experimental animals. The first, control group of rats received physiological solution. The remaining 4 groups were treated with Dex at a dose of 0.6 mg/kg bw or 3 mg/kg bw and MPA at a dose of 30 mg/kg bw or 150 mg/kg bw. The substances were applied intramuscularly, for 15 days. All the procedures concerning manipulation with the animals were in accordance with the legal legislatives for experimental work with laboratory animals. The rats were sacrificed 24 hours after the application of the last dose of the used substances, after anesthesia with ether. After the opening of the abdomen and chest and after the bleeding from

the aorta, the thymus was removed. Paraffin sections were stained with the following methods: H&E, elastica Van-Gieson and PAS-method. Histological analysis in the medically treated group of rats showed significant reduction of thymic lymphoid tissue and increased representation of stroma. In addition to the dominant immunosuppressive effect of Dex and MPA on the thymic parenchyma, secondary morphological changes were also observed: irregular thymus lobularization, accumulation of lymphocytes around the blood vessels, the occurrence of microcysts and bleeding in the thymic tissue. Comparing the results about the structural side effects, we concluded that long-term administration of Dex and MPA caused almost identical side effects on the thymic tissue.

P1-MA17

Myocardial and adipose tissue macrophage populations and crown-like structures are associated with cardiovascular and metabolic disease in heart surgery human patients

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Our aim was to compare M1 and M2 populations of macrophages and occurence of crown-like structures simultaneously in three anatomical locations, i.e., myocardium from the right atrium (RA), and epicardial (EAT) and subcutaneous (SAT) adipose tissue, in patients with obesity, coronary artery disease (CAD) and type 2 diabetes mellitus (T2DM). It is assumed that CD68+ cells/macrophages and crown-like structures are potent source of pro-inflammatory cytokines in both adipose tissue and myocardium and thus they can contribute to the pathogenesis of these diseases. Samples of human tissue were obtained during elective heart surgery (non-obese, n = 34 patients; obese, n = 24 patients). The study was approved by Human Ethics Review Board. The CD68+ cells were visualized by immunohistochemical method (macrophages marker CD68-PG-M1, M1 phenotype marker CD11c, apoptotic cell marker cleaved-caspase 3 and cleaved-lamin A). A fraction of EAT and SAT samples was analyzed also using flow cytometry (macrophages marker CD14+HLA-DR+, M1 phenotype marker CD11c+, M2 phenotype marker CD163+CD206+). Only weak association between number of macrophages in both adipose tissue and myocardium suggests importance of their phenotype. M1 phenotype of macrophages in adipose tissue was strongly associated with presence of the crown-like structures. Presence of crown-like structures in SAT is associated with all analyzed pathologies, presence of crown-like structures in EAT is associated with obesity and CAD, but not with T2DM. This result demonstrates that the phenotype of macrophages is important for development of pathological processes in the adipose tissue associated with obesity, CAD and T2DM. Our results support the hypothesis that behaviour of SAT and EAT might be sligthly different.

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P1-MA18

A Comparison of Histomorphometric Variables in Long Bones from Scottish and Thai Populations

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The variability of bone histomorphometric parameters between different human populations has not been well studied. Therefore, in order to better understand the variation in histomophometric parameters in geographically separated human populations we examined osteon variables from samples of human femora obtained from two modern populations, one in Thailand (Th, n=24 mean age = 81.03 yrs) and one in Scotland (Sc, n=24, mean age = 84.29 yrs). Six variables were examined: area, perimeter and diameter of Haversian canals, and of secondary osteons. Each variable was measured in transverse sections taken from proximal (one fourth of the proximodistal length), middle and distal (three fourths of the proximodistal length) shaft, and for each section, the bone was divided into four quadrants (anterolateral, anteromedial, posterolateral and posteromedial) resulting in the examination of 12 different bone regions. As the parameters were found to not be normally distributed (Shapiro-Wilk test) we used Mann-Whitney tests to compare the median of variables between Scottish and Thai samples at each of the 12 sites.
We found that the Scottish population exhibited statistically significantly ($p < 0.05$) larger values for all parameters at all sites, with the exception of the Haversian canal diameter in the anteromedial quadrant of the distal section, where no statistically significant difference was observed.
The reasons for the observed differences are unknown, but nutritional, genetic and environmental differences, likely in combination, are potential explanations. In addition to the inherent biological significance of these results, they may also have implications in terms of assessment of ethnicity as part of establishing a biological profile in the context of forensic investigations. Ethical approval was not required for this study.

P1-MA19

Voronoi tessellation for quantification of microvascular pattern in histological section of human myocardium

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Quantitative description of structures in the histological section allows better discrimination between different pathologies. The added value of the descriptor can be a tight association with the biological function of analyzed tissue. Microvascular density, i.e., mean number of small vessels perpendicular to the plane of section in unit of surface, is usually used for a description of the microvascular network. In order to improve the description of the point-pattern of the small vessels, we have used Voronoi tesselation. We have used samples of human myocardium harvested during cardiac surgery for purposes of another research approved by the ethics committee. Further analysis of samples has been allowed by the informed consent described by each participant. We have been blinded to all clinical data of participants. Samples of the myocardium have been processed for routine immunohistochemical staining, CD31 immunostain was used and representative images have been obtained. Small vessels have been selected manually. The coordinates of the marks have been used as coordinates of the centerpoints for Voronoi tessellation. We have tried to use the Pareto's, log-normal, and gamma distribution. Using the Akaike information criterion, the log-normal distribution has given the best result of fitting, i.e., the mean and the standard deviation of logarithms of areas of Voronoi cells describe the microvascular pattern by the best way. Attempt to construct the linear model binding these two parameters with the cardiomyocyte diameter and area of fibrosis has failed in sense of good explanation of variability. This observation indicates that the microvascular pattern in myocardium is not driven by the diameter of cardiomyocytes and amount of connective tissue only. We have also demonstrated that the Voronoi tessellation is a useful tool to description of the microvascular pattern in the histological sample.

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P1-MA20

Refining the histological nomenclature of the epithelium of human uterine tube

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Introduction. The histological findings in normal human uterine tubes have been described sporadically in the scientific literature. The major reason for the lack of investigation in this regard has been the success of in vitro fertilization techniques in which the uterine tubes are bypassed. This has decreased the medical community's interest in studying tubal morphology. According to the internationally accepted and still-valid nomenclature Terminologia Histologica, four types of cells can be distinguished within the simple columnar epithelium of the uterine tube, including ciliated epitheliocyte, tubal secretory epitheliocyte, peg (intercalary) cell and basal epitheliocyte. The present research focuses on clarifying the nature of the basal cells and peg/intercalary cells within the human tubal epithelium. This work is important for refining the histological nomenclature. Patients and methods. Uterine tubes were obtained from 22 women in fertile age. The women were undergoing gynecological surgery. This study was approved by the Local Ethical Committee of the General Hospital, where the tissue samples were obtained. For immunohistochemistry, we use antibodies: Ki67, PCNA, CD3, CD4, CD8, CD20, CD45RO, CD56, and granzyme B. Results. Most of the mature tubal epithelial cells, ciliary cells, and secretory cells were mitotically active (PCNA+). The actually dividing cells had a narrow-shaped nucleus (Ki67 positive). The tubal "basal cells" located in the epithelium adjacent to the basement membrane, were non-mitotically active and their immunophenotype corresponded to intraepithelial regulatory T-lymphocytes (CD3+, CD8+, CD45RO+, CD4-, CD20-, CD56- and granzyme B-). We recommend removing the term "epitheliocytus tubarius basalis" from the TH and replacing it with "lymphocytus T intraepithelialis tubarius." Additionally, we propose that intercalary/peg cells are actively dividing (due to their extremely narrow, Ki67+ nuclei), and not effete or degenerating cells. Acknowledgement. Research was supported by a Grant from the Slovak Research and Development Agency APVV-18-0499.

P1-MA21

High intensity interval training in rats shoulder osteoarthritis, for better or worse?

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Osteoarthritis (OA), is a degenerative cartilage disease, resulting in functional loss. Monosodium iodoacetate (MIA) has been demonstrated to be useful to generate cartilage damage in a short time period. It has been demonstrated that exercise contributes to articular cartilage preservation in animals with OA. On the contrary, excessive exercise has been demonstrated to be detrimental to articular cartilage. Nevertheless, there are a lack of histological studies about the effects of treadmill high-intensity interval training (HIIT) in humeral OA induced by MIA.
Twenty female Sprague-Dawley 200 to 250g rats were used, with Ethics Committee approval. Rats were randomized into four groups: No exercise, No drug (Control); Drug and no exercise (Drug);

Continuous moderate training and drug (CMT) and High-Intensity Interval Training and drug (HIIT). Rats were treadmill adapted for one week. Next, CMT and HIIT rats were injected with MIA in the left humeral joint. The training protocol began 4 weeks post-injection.
The treadmill training consisted of a 4-week program. HIIT: Velocity 43.3 cm/s, fifteen sets with intervals of one minute run and one minute rest. CMT: Velocity 31.6 cm/s continuous running for 30 minutes. The whole humeral joints were then decalcified with 20% EDTA for 21 days. Shoulder histological serial sections were graded using a Modified Mankin and OARSI Scoring System.
Control group showed normal cartilage characteristics. Drug group showed signs of moderate OA, (Mankin score: 7 and, OARSI: OA level 2), after eight weeks. Articular cartilage presented structural alterations in the superficial and middle zones where chondrocytes were poorly organized in columns in the intermediate and deep zones; moreover, a reduction of thickness was observed, also vascular vessels rising from subchondral bone to the calcified cartilage. The CMT and HIIT groups exhibit normal articular cartilage structures, having smooth cartilage surface, columnar chondrocytes orientation and chondrocytes proliferation, a higher rate of proteoglycan content in the superficial, intermediate and Deep zone. The cartilage thickness was similar to the Control group.
Our findings indicate that mechanical stress by the HIIT protocol was not detrimental to articular cartilage and contributes to the preservation of joint cartilage in rats shoulders with OA.

P1-MA22

Troxerrutin Reverts Morphological and Inflammatory Modifications of Intestinal Mucosite Model

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Intestinal mucositis is a complication associated with the chemotherapy treatment 5-fluorouracil (5-FU) that promotes several microscopic changes with decrease of the height of the villi and crypt, increase of inflammatory infiltrate and decrease of the intestinal absorption. Troxerrutin (TRX) is a semi-synthetic flavonoid extracted from Dimorphandra gardneriana endowed with pharmacological activities as anti-inflammatory and anti-oxidant. The objective of this work was to evaluate the effect of TRX on histological changes, myeloperoxidase and malonylaldehyde induced by 5-FU in intestinal mucositis in Swiss mice. This work was approved by the UFC Animal Use Ethics Committee (CEUA-UFC) nº 2413051018. The animals were randomly divided into three groups: Salina, 5-FU, TRX. After treatment, a sample of the duodenal segments was collected for histopathological evaluation. 5-FU promotes intestinal architecture impairment, characterized by reduced villi height and villi / crypt ratio, loss of epithelial integrity evidenced by vacuolation, edema and intense inflammatory infiltrate compared to saline group. On the other hand, TRX reduced the histological changes promoted by 5-FU, decreased levels of myeloperoxidase and malonylaldehyde. It was found that the TRX reversed the morphological and inflammatory changes induced by chemotherapeutics preserving tissue morphology.

P1-N2

Enlarged Emissary Sphenoidal Foramen or duplication of Foramen Ovale? Unusual anatomical findings on human skull bases, with clinical implications

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During the course of our regular tutorial classes of Anatomy for undergraduates of the Nova Medical School of Lisbon, one of the students brought to our consideration the finding of a peculiar variation of the skull base foramina, in which she recognized duplication of the left foramen ovale. To the left, the medial foramen is 0.3 cm wide, and the lateral foramen, 0.5cm, whereas the single right foramen ovale has a width of 0.7 cm. This unilateral variation reminded us of the original Vesalius works, 1543. To our knowledge, and considering the classical and modern bibliography, we find no other description of such wide duplication or division of the foramen ovale, even when we consider the possibility of finding ossified Pterygospinous or Pterygoalar bars, to be more frequent unilaterally, on the left side. Further analysis leads us to consider the possibility of an enlarged foramen venosum / emissary sphenoidal foramen (Vesalius). In the absence of CT scans of the living individual, to determine the content of this unusual unilateral variant of the skull base, we present photographic material for further analysis and discussion, under the light of comprehensive bibliographic research. We complete the research with some other peculiar variations of the skull base foramina, collected from the University of Pernambuco, Brazil, and from the Kapodistrian University of Athens, Greece, in International cooperative work. There is evident clinical interest in the presentation of variations of the foramina of the middle fossa of the skull base, to further understand neurovascular entrapment symptoms, or to prevent the obstruction of surgical approach in the treatment of trigeminal neuralgia. The knowledge of the possible anatomical variations will further improve the end-quality of neurosurgical procedures, such as guided gasserian rhyzotomy.

P1-N3

Reid's base line and its significance to Neurosurgeons

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Robert William Reid (1851 – 1939) was a Regius Chair of Anatomy at the University of Aberdeen from 1889 till his retirement in 1925.

Whilst working at St Thomas's hospital in London in 1884 he proposed a simple and reliable guide for anatomical localization of cerebral gyri and sulci. He conducted a series of dissections and correlated his findings based on surface anatomy and with his now eponymous 'base line'. This runs through the lowest part of the infraorbital margin and the middle of the external auditory meatus. In 1962, the World Federation of Radiology redefined it as a line between inferior margin of the orbit and the upper margin of the external auditory meatus. It is used as a guide not only for conventional radiography but also for modern cross sectional imaging including Computerised Tomography and Magnetic Resonance Imaging. It has also guided pioneering neurosurgeons to carry out intracranial explorations safely.

Prof. Reid during his tenure in Aberdeen established an anthropometrical laboratory in 1896 that laid the foundation for significant work studying the growth of children. In 1907, he succeeded in bringing together the disparate collections of anatomical, archaeological and anthropological material that then existed within the University to form the University of Aberdeen Anthropological Museum for which he remained its Honorary Curator until 1937. In his honour, a Reid Lectureship in Anthropology was founded at Aberdeen University and the inaugural lecture was given by him on December 3, 1934.

P1-N4

Prof. Albert Rhoton - Father of Microsurgical Neuroanatomy

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Prof. Albert Loren Rhoton Jr. (18/11/1932 – 21/02/2016) practiced neurosurgery in the USA for over half a century and made major contributions to our understanding of microsurgical neuroanatomy.

He was born in rural Kentucky in the United States and had very humble beginning including repeating fifth grade. After qualifying from Washington University School of Medicine in St. Luis in 1959, he completed his neurosurgery training at Barnes Hospital under Dr. Henry Schwartz in 1964. He stayed at Washington University for a one-year NIH (National Institute of Health) research fellowship in neuroanatomy during which time he began to use the surgical microscope and realized its potential to revolutionize surgery and also take cerebral anatomy to a greater level of detail.

During his long and distinguished career spanning five decades he developed and introduced a number of microsurgical techniques that improved the safety and effectiveness of neurosurgery. He also designed many micro neurosurgical instruments, which bear his name. These Rhoton micro dissectors are standard possession of every neurosurgeon undertaking intricate microsurgery for intracranial aneurysms and brain tumours.

One of his greatest legacies is establishment of excellent microsurgical dissection laboratory at University of Florida at Gainesville where neurosurgeons from around the world came for training. This included more than 1000 trainees and approximately 500 of those have returned to their home countries to establish centres of excellence.

Rhoton was a dedicated teacher and a prolific writer publishing more than 500 scientific papers many of which were related to microsurgical neuroanatomy. He pioneered 3D anatomical presentations now becoming a gold standard for neurosurgical training the world over. He was honoured by many professional organisations, the most noteworthy being a Medal of Honour bestowed upon him by the World Federation of Neurosurgical Societies in 2001. He will be remembered as “the Father of Microsurgical Neuroanatomy”.

P1-N5

Combination Psychedelic Therapy to Treat Substance Use Disorders: Insights from Human and Rodent Studies

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Ibogaine and 5-MeO-DMT have demonstrated rapid-onset anti-addictive effects. When used in combination, pre-treatment with ibogaine potentiates the dosage effects of 5-MeO-DMT which may be due to ibogaine’s NMDA receptor affinity. The therapeutic effects of both compounds in treating substance use disorders (SUDs) require further investigation and no published human neuroimaging findings of either treatment exist.

We present the case of a 31-year-old male with moderate alcohol use disorder who sought treatment at an inpatient clinic using a sequential protocol with ibogaine hydrochloride (1550mg, 17.9mg/kg) and 5-MeO-DMT (bufotoxin 5-MeO-DMT content, 5-7mg). The patient received SPECT neuroimaging before and after treatment.

Neurochemical changes following ibogaine were assessed using two groups, n=10, of male Sprague-Dawley rats to test ibogaine administration (single ibogaine HCl i.p. 50mg/kg) versus saline control following ethical clearance. Rats were euthanized and decapitated and right dorsal hippocampal tissue was obtained for qPCR analyses of GRIA1 mRNA expression relative to three reference genes.

On post-treatment SPECT neuroimaging, increases in brain perfusion were noted in the temporal poles, bilateral caudate nuclei, left putamen, right insula, and occipital and cerebellar regions compared to the patient’s baseline scan. The patient reported improvement in mood,

cessation of alcohol use, and reduced cravings at 5 days post-treatment, effects which were sustained at one month.
The results of the qPCR analyses showed a highly significant reduction in GRIA1 expression in the ibogaine treatment group relative to control ($p=0.003$).
Administration of ibogaine and 5-MeO-DMT resulted in increased perfusion in multiple brain regions broadly associated with alcohol use disorders which coincided with short-term therapeutic outcome. By down-regulating GRIA1 expression, ibogaine may prime glutamatergic neurotransmission, affecting the complex interplay between the serotonergic and glutamatergic systems which control neuronal excitability in networks involved in SUD. Combination psychedelic therapy may be synergistic in treating chronic, treatment-resistant SUD which warrants further investigation.

P1-N6

Endoscopic anatomy of the temporal horn of lateral ventricle

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Topographic relationships around the ventricular system, and the temporal horn in particular, are often a challenging topic for the first year students. On the other hand good spatial orientation within and around ventricles is essential for neuradiologists and neurosurgeons. Anatomical terminology by itself should be a guide to anatomy and should allow for full and adequate description of all relevant structures.
Brains of eight donators of both sexes, aged from 27 to 85 years, fixed in 10% formaldehyde were studied endoscopically (with rigid neuroendoscope) and dissected with microsurgical technique.
The main anatomical landmark within this part of the ventricle is the choroid plexus emerging from the choroidal fissure and attached superiorly along the taenia choroidea of stria terminalis, and inferiorly along the taenia fornicis of fimbria hippocampi and crus fornicis. Attachment of the choroid plexus indicates clearly the medial side of the ventricle. The second significant landmark is the collateral eminence caused by invagination of the collateral sulcus into the ventricle. Especially in the distended ventricle, two parallel grooves sharply border the collateral eminence. Medially the groove separating it from the pes hippocampi splits the parahippocampal gyrus from above. The lateral one may be regarded as "negative" marking of the fusiform gyrus (i.e. lateral occipitotemporal gyrus). Thus the medial groove could be called the parahippocampal groove (sulcus parahippocampalis) and the lateral the fusiform groove (sulcus fusiformis) - per analogiam to etymology of the collateral eminence. Anteriorly the temporal horn is limited by the tuberculum amygdalae.
Clear visualisation of elements forming the walls of ventricle, as well their conceptual linking with surrounding structures may be a key for optimal academic and clinical performance. The proposed new terms shoud be also helpfull.
The study was performed in accordance with local legal and bioethical regulations.

P1-N7

A Quantitative Analysis of the Cornu Ammonis of the Hippocampal Formation in Control Versus Seizure-Induced Sprague Dawley Rats

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Morphometry is an essential tool to study brain and its changes during development, aging, learning and disease. This method can help to quantitatively assess the changes that take place in the different areas of the brain (i.e., neural loss, neuroinflammation). For neurodegenerative diseases such as Alzheimer's, and Parkinson's diseases, as well as in epilepsy, morphometry is essential in quantifying changes taking place within the brain (i.e., the loss of neurons during temporal lobe epilepsy). The present research

seeks to quantitatively assess the changes occurring in the cornu ammonis (CA) region of the hippocampus during experimental seizures. The study was approved by the Ethical Committee of the University of the West Indies, Mona Campus, Jamaica. Kainic acid-induced seizures were generated in Sprague dawley rats. Rats presenting with at least a stage four seizure (classification of Racine) were sacrificed seven days after the seizure. The animals were euthanized using pentobarbital before perfusion with formaldehyde. The brains of the rats were harvested and serial coronal sections were stained with Nissl staining. These sections were digitized and two different software, Image J and QuPath, were used to assess the changes that occurred in the brain. These results were compared to the data measured in controls. We found that both software were effective in assessing the neuronal loss in the brain with no major difference in the results obtained. However, Image J appeared easier to handle and more user friendly, therefore it was chosen to complete the assessment.

P1-N8

A quantitative study of the placenta and brain in the reduced uterine perfusion pressure (RUPP) rat model of pre-eclampsia

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Pre-eclampsia is a hypertensive disorder affecting 5% of all pregnancies. PE exposure has been linked to abnormal neurodevelopmental outcomes in the offspring. This study examined placental and fetal brain structure using the reduced uterine placental perfusion (RUPP) rat model of PE. All procedures were performed in accordance with national guidelines with full ethical approval. After induction of RUPP on gestational day (GD14) under anaesthesia with isoflurane (2% to 5% inhalation), pregnant Sprague-Dawley rats were sacrificed at GD19 under terminal anaesthesia. The pups and placentae from sham (n=8) and RUPP (n=6), and brains from sham (n=5) and RUPP (n=5) embryos were removed and fixed 4% PFA and processed for routine histology. A number of stereological methods were employed to estimate placenta and brain composition. Placental parameters included the absolute volumes and volume fraction of the placenta and its compartments (decidua (D), junctional zone (JZ), labyrinth (L)), as well as of the blood vessels within the JZ and L. Brain parameters included absolute whole brain and cortical volumes, cortical thickness, neuronal nuclear volume, numerical density and tubulin III area fraction. Results showed a reduction of the JZ volume, of blood space within JZ and L, and altered L to JZ ratio in placenta from RUPP pregnancies compared to Sham. Whole brain volume, cortical volume and cortical thickness were no different, however there was an increment of neuronal nuclear volume associated to a numerical density reduction in RUPP compared to Sham. These data suggest that RUPP leads to subtle morphological alterations in the placenta and fetal brain that may underlie the abnormal neurodevelopmental outcomes in the PE-exposed offspring.

P1-N9

Histological and Immunohistochemical Assessment of Gasoline Vapour Inhalation on the Olfactory System and Hippocampus of Adult Albino Wistar Rat

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Adverse effects of gasoline inhalation include hallucinations, dizziness, nausea and vomiting. Hydrocarbons in gasoline act as a central nervous

system suppressant. Rats were exposed to gasoline vapour via inhalation to assess the effects on the olfactory system and the hippocampus. Approval was obtained from ethical committee of Faculty of Basic Medical Sciences, University of Calabar. Thirty five rats (n= 7, groups 1-7) were exposed for 0, 5, 10, 15, 20, 25 or 30 minutes daily respectively for twenty one days and the concentration of gasoline vapour was measured using an air quality monitor. The concentration of gasoline vapour obtained during each exposure period was 0 ppm, 16,737ppm, 20,240ppm, 23,077ppm, 27,344ppm, 30,920ppm and 34,458ppm.The nasal cavity, olfactory cortex, olfactory bulb and hippocampus were dissected, fixed in 10%formal saline for histological, neurohistological and immunohistochemical assessment using Haematoxylin and Eosin, Cresyl violet and GFAP staining techniques respectively. Superoxide dismutase, Malondialdehyde and Catalase were assessed for oxidative stress. Spatial learning and memory in the rats was assessed using the Morris water maze test Results indicated that MDA levels increased, while the SOD and CAT levels decreased. Increased mean time for Morris water maze test was observed indicating adverse effect on learning and memory.Using light microscope,histological and neurohistological analysis revealed degeneration of sustentacular cells, loss of the apical surface of the olfactory epithelium, pyknosis, karyolisis and hypertrophy of mitral cells in the olfactory bulb and pyramidal cells in the olfactory cortex, degeneration and cell loss in the pyramidal layer of the hippocampus. Staining intensity of Nissl's substances ranged from reactive to less reactive indicating reduction in protein synthesis in neurons in the olfactory bulb, olfactory cortex and hippocampus. GFAP assessment revealed the presence of reactive astrocytes. Gasoline vapour inhalation probably exert adverse effects on the olfactory system and the hippocampus by oxidative stress mechanism.

P1-N11

Rap1GAP effects on the proliferation, migration and invasion in glioma cells

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As a tumor suppressor gene, RapGAP has been gradually recognized. Here, the expression and function of Rap1GAP was explored in glioma cell lines. Firstly, Western Blot and immunofluorescence techniques were used to detect the expression of Rap1GAP in normal astrocytes and glioma cell lines (U87, U251 and U118). The lower expression of Rap1GAP was exhibited in glioma cell lines. Then, in order to identify its function, virus with overexpressed Rap1GAP gene was used to infect glioma cells, and further confirmed the expression of Rap1GAP by Western Blot. Additionally, the effect of overexpressed Rap1GAP was observed, cell growth was determined by CCK-8 and flow cytometry, and transwell chamber was used to show the cell invasion and migration. Results showed that Rap1GAP overexpressed in glioma cell could hinder cell growth associated with the protein expression of Rap1, Rap2 and ERK. Rap1GAP also could inhibit cell migration by regulating the expression of integrin. While, overexpressed Rap1GAP enhanced the invasion of glioma cells accompanied with high MMP2 and MMP9. We also explored the reasons of Rap1GAP down-regulatied may be related to methylation modification. This study may provide new ideas for the research and treatment of glioma.

P1-N12

Differential expression of chondroitin sulfates in perineuronal nets after complete spinal transection in neonatal rats

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Hind limb locomotor activity spontaneously recovers after complete spinal transection (CST) in neonatal rats, but not in juvenile rats. The mechanisms underlying the differences in the recovery between neonatal and juvenile rats, however, are poorly understood. We performed CST at the mid-thoracic level in neonatal rats (postnatal day 5 [P5] and P10, CST-neo), and in juvenile rats (P15 and P20, CST-juv) under anesthesia with isoflurane gas, then examined the primary afferent projections to the spinal motor area at the level below the CST by injecting biotinylated dextran amine into the dorsal root ganglion. The axonal length and number of terminal boutons were significantly higher in CST-neo and CST-juv at P40 than in intact rats. No significant differences were detected between CST-neo and CST-juv.

The perineuronal net (PNN) surrounding the neuronal cell bodies regulates neuronal plasticity during development. Therefore, we next examined the expression of chondroitin sulfate (CS), a major component of the PNN, in motoneurons after CST. Two weeks after CST, the percentages of motoneurons with chondroitin sulfate A (CS-A)–positive PNNs and CS-C–positive PNNs were significantly lower in CST-neo than in intact rats. In contrast, while the percentage of motoneurons with CS-A–positive PNNs was significantly lower in CST-juv than in intact rats, the percentage of motoneurons with CS-C–positive PNNs tended to be higher in CST-juv than in intact rats.

These results suggest that there is differential expression of CS-A and CS-C in the PNNs of rats with CST. The decrease in CS-C–positive PNNs might facilitate new contact formation between the primary afferents and motoneurons, resulting in recovery of locomotor activity in rats with CST during the neonatal period.

The protocols were approved by the Institutional Animal Care and Use Committee of the Animal Research Center, Yokohama City University Graduate School of Medicine.

P1-N14

Silencing microRNA-134 in ventral hippocampus attenuates anxiety-like and depression-like behaviors in cocaine extinction mice

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MicroRNA-134 (miR-134) is abundantly expressed in the hippocampus and play important roles in the process of brain development and neuropsychiatric disorders. The present study aims to explore whether miR-134 involves in cocaine exposure related psychiatric disorders and the mechanisms by which miR-134 influence addiction. In models of cocaine conditioned place preference (CPP), we found an enhanced anxiety and depression levels in cocaine extinction mice, accompanied by a significant upregulation of miR-134 level specifically in the ventral hippocampus (vHP). In parallel, some potential target genes of miR-134 related synaptic plasticity and neurochemical environment, including BDNF and CREB are markedly reduced in the vHP. As expected, synaptic plasticity and microenvironment were impaired by cocaine addiction. Most importantly, local silencing miR-134 in the vHP ameliorated the abnormal behaviors and reversed almost all the above changes in molecules induced by cocaine extinction in the vHP. Thus, miR-134 signaling pathway might become a promising therapeutic target for treatment of addiction. The mouse was anesthetized with overdosed isoflurane, mice usage was in accordance with protocols approved by the Institutional Animal Care and Use Committee at the Nanjing University of Chinese Medicine.

P1-N15

Active learning and tactile resources in undergraduate neuroanatomy teaching: Is it time

to smash the screen to counter 'neurophobia'?

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Numerous studies have highlighted a UK-wide deficit in neuroanatomy teaching. 'Neurophobia' has been reported in undergraduate cohorts, primarily due to the perceived complexity associated with neuroanatomy. We investigated surgically-relevant neuroanatomy resources, and the effects of these resources upon perceived learning and attainment. A systematic review of the literature was conducted using the PRISMA system. 77 records were identified using a Medline and Embase search. Pilot data from feedback and reflections (n = 151) concerning teaching within the Newcastle University Neurological Society collated over a three-year-period were subject to qualitative and quantitative analysis. Innovative pedagogies including 3D anatomy, computer-aided anatomy, neurosurgical videos, and case-based learning were all highlighted as beneficial options to improve medical student understanding of neurosurgical anatomy. 'Tactile' resources utilised for the cohort scored consistently highly on a 5-point Likert scale. These included spinal pathway (mean = 4.6 ± 0.63, n = 65) and cerebral vasculature (mean = 4.75 ± 0.50, n = 36) routing boards. These resources represent a notable departure from primarily screen-based learning tools. The process of such active learning has been described within the literature regarding enhancement of surgical training. Student-centred learning can increase the motivation to acquire knowledge and deepen understanding of subject material. The literature review and results from the small (a limitation) investigated sample indicate the need for targeted and tailored augmented neuroanatomical teaching resources utilising a range of innovative tools and techniques. This pilot study serves to illustrate that a diverse and augmented neuroanatomy toolkit should be integrated within medical curricula to alleviate the worrying trend of 'neurophobia', and raise the profile of neurosurgery as a specialism worthy of consideration for surgically-minded graduates.
Consent for the use of students' pilot feedback data was secured during student registration with Newcastle University Neurological Society. Ethical approval is not required for pilot studies.

P1-N16

Decrease in Mesocortical Dopaminergic Neurons and Fibers is Associated with ADHD in rats

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Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized with attention deficit, locomotor hyperactivity and impulsivity. Although no single hypothesis is accepted in the etiology of ADHD, research suggests that all symptoms in ADHD are resulted from the dysfunction of different synaptic circuits in the prefrontal cortex. Based on the hypothesis that this dysfunction is due to the reduction of dopaminergic neurons and fibers, we aimed to investigate whether there is a decrease in neuron and fiber density of the dopaminergic mesocortical pathway.Five SHR juvenile male rats as animal models of ADHD and three WKY juvenile male rats as control were used in this study. TH immunohistochemistry was used to identify dopaminergic neurons in VTA and dopaminergic fibers in mPFC, dopamine beta hydroxylase (DBH) immunohistochemistry was used to identify noradrenergic fibers. Quantification of density of TH-immunolabeled (TH-positive) DAergic fibers was performed and percentage of TH (+) Daergic fibers in the PrL subregion of mPFC was evaluated. We also quantified the TH (+) DAergic neurons density in the VTA. Data were analyzed with independent sample t test and Mann Whitney U test. We observed statistically significant decreasing TH (+) neurons in the VTA rats (p=0,04) and TH (+) fibers in the mPFC (p=0,02) of the SHRs compared to

the WKY. There was no significant difference in the percentage of TH positive dopaminergic fibers in mPFC between WKY and SHR (p=0,7).Conclusion: There was a decrease in mesocortical dopaminergic neurons and fibers in juvenile SHRs used as an animal model of ADHD. We observed that the percentage of TH (+) dopaminergic fibers in mPFC did not change. These findings indicate that noradrenergic fibers as well as dopaminergic fibers decrease in ADHD.

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P1-N19

The lamina cribrosa – new concept Is the cribriform plate an effective border?

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Lamina cribrosa are locus minoris resitentiae to the anterior skull base area, a trauma particularly. There are a spere to study resorption of cerebrospinal fluid. Which are anatomical basis from liquor resorption in this area? Which is function into skull base between structures gong through it and brain mater?

The study was executed in two divisions in reality – macroscopic bone study and microscopic study this area. The dry bone material was cut in thin slice in horizontal, sagital and vertical level, it was study macroscopically, 2,5 – 7,5 magnify. The colourish of mounts by agent hematoxylin-eosin and the second metod was Bodian´s metod.

The lamina cribrosa is complicated labyrinth oss, no simple perforated plate. We find system of cellules going together with the nerves in its passage-way, which connected with arachnoidea, subarachnoideal space and olfactoric cistern, The physiological undulation of the fibres, Fontan´s striated is perceptible on the nerve fibres. We demonstrated during the study of the junction in area of the passing-way structures through skull base.

The lamina cribrosa is labyrinth bone, into which the plexus nervosum nervi olfactorii develop, the venous plexus of thinwall veins, with cavernous or sinusoid character,, the arachnoideal villi and microvilli passing-way into canaliculli togerther with nervi olfactorii, but partly independently to, the arachnoideal villi probably function to cerebrospinal fluid resorption. The junction of structures passing form intracranium to extracranium in this area is very gently, fragile, and developing limit permeability in arachnoideal layer. The cribriform plate and olfactory structures are very important from function – as smelling, tasting and sexual-behavioral functions. The area of cribriforme plate is very important from aspect of intracranial function study, especially in relation to resobction problem of cerebrospinal fluid.

Is the cribriforme plate an effective border?

P1-N21

Functional abnormalities of auditory brainstem in autism model animal by thalidomide exposure to pregnant rats

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Autism spectrum disorder (ASD) is associated with hypersensitivity to sensory stimuli. Pathogenesis of sensory hypersensitivity was not been known to date. We have previously established autism model rats induced by thalidomide to pregnant rats and recently reported that autism model rats have morphological abnormality of medial nucleus of trapezoid body (MNTB), a nucleus of superior olivary complex (SOC) in auditory brainstem. However, the auditory function have not been elucidated yet.

To clarify the auditory function of autism model rats, we performed the morphological study of neural activity in SOC of autism model rats after sound stimulation.

All animal experiments were approved by the animal research committee at Mie University. Pregnant Wistar rats were exposed to thalidomide (500 mg/kg in 5% gum arabic) on

embryonic day 9 and 10. On postnatal day 50, the animals were placed in a sound-attenuated box for 30 min without any auditory stimulation, followed by a 16-kHz (62 dB) for 1 hour. Immediately after, the animals were anesthetized and perfused transcardinally with 4% paraformaldehyde. Then, the whole brain was dissected out, sectioned at a thickness of 50 mm and performed immunohistochemical analysis using anti-c-Fos antibody.

After sound stimulation, c-Fos-positive neurons were present clearly in the control rat in the putative 16-kHz tonotopic band in MNTB. In the autism model rat, c-Fos-positive neurons occurred outside the tonotopic band extending to the medial part of the MNTB, which should be responsive to higher frequencies. In addition, there were significantly more c-Fos-positive neurons in the MNTB of autism model rats than in control rats.

These results indicated that the autism model rats had an auditory dysfunction for sound stimulation. It was suggest that abnormalities in the auditory brainstem may cause auditory hypersensitivity in human autism.

P1-N22

Enhanced survival of motoneurones in rats raised on an obesogenic diet.

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Increased adiposity is associated with increased levels of circulating inflammatory cytokines. Age-related increases in inflammatory levels have also been implicated in the pathogenesis of age-related neurodegenerative diseases. The effect of obesity-induced cytokine changes on neuronal survival, however, is unclear. Here we have compared cytokine levels and motoneuronal survival in adult rats raised on an obesogenic high-fat diet (HFD) with those raised on a standard chow diet (SCD).

Rats were either raised from weaning on a commercial HFD or a SCD. At 3 months, groups of 6 rats on both diets were anaesthetised and the right facial nerve avulsed. Rats were maintained postoperatively for 1 month on their original diet, before anaesthetising and perfusion-fixation. Total numbers of facial motoneurones were determined stereologically. Multiplex analysis of 12 cytokines (IL-1α, IL-1β, IL-2, IL-5, IL-6, IL-10, IL-13, GM-CSF, IFNγ, TNFα) was carried out at 3m for groups of 3 non-operated anaesthetised rats on both diets.

HFD rats were 30.5% heavier than SCD rats at 4m ($p < 0.05$) but showed no significant change of activity levels as determined by an open field test. Pre-operative (3m) HFD rats showed a 98.7% ($p < 0.05$) decrease in brainstem levels of IL-10 compared to NCD rats. One month following facial nerve avulsion, 54.5% of motoneurones of NCD rats were lost, whereas no significant loss was found for HFD rats ($p<0.05$).

Our results show that an obesogenic diet is associated with a reduction of an anti-inflammatory cytokine in the brainstem and protection of avulsed facial motoneurones.

This study was approved by The University of Adelaide Ethics Committee (M-2013-057C).

P1-N23

The Immunoreactivity of PI3K/AKT Pathway After Prenatal Hypoxic Damage in rats

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There is no consensus on the effect of hypoxia on neurogenesis. In this study, we investigated the immunoreactivity of BDNF and PI3K/Akt signaling after uterine artery ligation in pregnant Sprague-Dawley rats.

All animal experiments were approved by the Chosun University Institutional Animal Care and Use Committee (approval number CIACUC2015-A0018). Unilateral uterine artery ligation was performed at 16 days of gestation (dg). Fetuses were delivered by cesarean section at 21 dg. Fetuses from one horn with the unligated uterine artery were allocated to the control group (n=47) and those from the other horn with the ligated

artery were allocated to the hypoxic group.(n=45). Serial coronal sections of 12 µm thickness were cut and the sections were chosen at regular intervals from each animal. Immunohistochemistry was performed with antibodies; NeuN, BDNF, PI3K, Akt and pAkt.

The densities of NeuN- and BDNF-immunoreactive (IR) cells in the cerebral cortex were lower in the hypoxic fetuses than in the controls at 21 dg. The density of PI3K and pAkt-IR cells in the parietal cortex of the hypoxic group significantly decreased. The results in dentate gyrus were similar to the results in the cerebral cortex.

These results suggested that prenatal hypoxia reduced Akt phosphorylation, which affected neuronal survival in the cortex and dentate gyrus.

P1-N24

Genetic Polymorphisms of Human MTHFR gene in Neural Tube Defects.

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The present study was done in the Anatomy Department of JIPMER, Puducherry, South India in collaboration with departments of Neonatology, Obstetrics and Gynaecology and Biochemistry. A study was attempted to describe the various forms of NTDs and to correlate with the neural tube development. Research Ethics Committee clearance was obtained.

The aim of the study was to study the frequency and association of maternal C677T Polymorphisms of MTHFR gene in neural tube birth defects among cases and control groups in South Indian population.

Two groups were studied (cases and controls), with a sample size of 36 and 72 respectively. After obtaining written and informed consent from the participants of study and control groups, a brief antenatal history was taken as per the data proforma.

DNA was isolated from the collected 5mL peripheral venous blood samples (both cases and controls) with Qiagen DNA Extraction Kits. Quantification of DNA was done using Nanodrop technique. The target DNA sequence was amplified and polymorphism related to SNP C677T (rs18011133) of maternal MTHFR gene was determined by Real-Time PCR technique, by using gene-specific primers and probes. The frequency of mutant and wild type SNPs of the MTHFR gene, its association with NTDs was documented in both study and control groups. The Data were analysed with GraphPad Instat software. Chi-square tests were used for the assessment of genotype frequency association between cases and controls. Fischer exact test with the approximation of woolf, was done to find out the association and the odds ratio of homozygous variant in comparison with the other mutant genotypes.

It was observed that the frequency of mutant maternal MTHFR gene in particular C677T (rs18011133) was higher in cases compared to controls.

To conclude, further studies are required eventhough the association between the mutant C677Tpolymorphism and the development of NTDs was statistically significant

P1-N25

Total number of olfactory receptor neurons in human olfactory epithelium

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The earlier study reported that the total number of the olfactory receptor neurons (ORNs) in the human olfactory epithelium (OE) was 6,000,000, by multiplying representative neural density and surface area. However, our recent studies in rodents showed density of ORNs differed depending on the regions of the OE and it is

difficult to estimate the total number of the ORNs without using a stereological method.
Thus, the purpose of this study was to estimate the statistically accurate total number of ORNs in the human OE by using a stereological method.
Under the approval of the medical ethics committee of Shinshu University School of Medicine, human nasal cavities were collected from 5 donated cadavers and used in this study. After sectioning and immunohistochemical staining for the olfactory marker protein (OMP) and protein gene product 9.5 (PGP 9.5), the number of OMP or PGP 9.5 positive cells was quantified by using stereological software (Stereo-investigator). The OMP was used as a marker for mature ORNs which connect to the olfactory bulb and PGP 9.5 is used as a pan-neuronal marker.
The results of OMP or PGP 9.5 immunohistochemical staining showed that human OE also has different densities in different regions. Estimated OMP positive ORNs were approximately 8,600,000 ± 1,000,000 and PGP 9.5 positive ORNs were approximately 12,600,000 ± 1,000,000 in the bilateral OE of the human.
We conclude that humans have approximately 12.6 x 10^6 ORNs in the bilateral OE and approximately 70% of ORNs are mature and connect to the olfactory bulb.
It is known that the number of ORNs decrease in aged mammals. Therefore, a limitation of this study was the age of the cadavers. Thus, the total number of ORNs are possibly higher in younger humans.

P1-N27

Volumetry of Insular Cortex in Diagnostics of Alzheimer's Disease

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Innovative approaches to Alzheimer's disease and its treatment depend mainly on early diagnosis and differentiation from other kinds of dementia. In our research, we focused on using MRI for measuring insular cortex and its atrophy that progresses with advancing disease. We deem this area as one potential biomarker for early diagnosis.
Our goal was to prove that assessment of volume of interopercular space would be a step in creating a visual scoring system by semiquantitative analysis used in diagnosing Alzheimer's disease. Secondarily, we aimed to differentiate AD from other dementias.
The analysis contained MRIs of 15 AD patients and 15 control persons. Patients repeatedly undertook psychological tests battery examined by a neurologist and were divided into groups according to their age. Using the software ImageJ, the approximate volume between insular opercula was measured and statistically compared by the programme Statistica10. The measurements were performed on insular lobe on every slice of MRI from its first anterior appearance to the level between crura cerebri and mesencephalic tegmentum.
After statistical comparison of measured volumes for both the right and the left hemisphere, T-test revealed significant results for both sides ($p(R) = 0.0003$ and $p(L) = 0.0006$). Not only the volume but also the average value was statistically significant on both sides ($p(R) = 0.000005$ and $p(L) = 0.00002$). While measuring only the atrophy affecting the frontal or the parietal operculum, the same trend was observed.
The statistically significant results support the idea of using insular atrophy as a feature of Alzheimer's disease and its potential diagnostic marker. A bit weaker significance on the left side offers a possible connection with the lateralised atrophy of the temporal lobe in hippocampal area – also right-sided. The difference in atrophy of the

frontal and parietal parts of insula could potentially lead to easier differential diagnosis.

P1-N28

LEDA-1/PIANP influences adult hippocampal neurogenesis and morphology of the adult mouse brain

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LEDA-1/PIANP, which is highly expressed in neural tissue, has recently been identified as a ligand of the inhibitory immunoglobuline-like type 2 receptor PILRa. A homozygous PIANP loss-of-function mutation is associated with symptoms of global development delay and intellectual disability in humans, which suggests an expression of PIANP in the brain. PIANP-mRNA could be detected in different brain areas by in-situ hybridisation, e.g. the cerebellum, hippocampus and cortex. Thus, the PIANP-expressing cells seem to be mainly of neuronal origin.
To further investigate the role of PIANP in the brain and its influence on brain morphology, we analysed PIANPcre homozygous knockout mice and compared them to both mutant mice floxed at the PIANP locus and wildtype C57Bl6/N mice.
Mice were anaesthetised with CO2 and killed by exsanguination, in accordance with the relevant local authority (Landesamt für Landwirtschaft, Lebensmittelsicherheit und Fischerei Mecklenburg-Vorpommern) and institutional guidelines.
For a basic analysis of the three animal lines we determined brain weight and volume. This investigation revealed increased brain volume and weight of PIANPcre mice. A subsequent analysis of the thickness of different brain structures unveiled an increase in the mean thickness of specific layers in the hippocampus, especially the dentate gyrus (DG). To assess the influence of PIANP on adult neurogenesis, which takes place in the hippocampus, we performed immunohistological analyses of cell proliferation, differentiation and apoptosis in the DG.
A lack of PIANP significantly altered adult hippocampal neurogenesis, seen in increased cell differentiation. Interestingly, PIANPcre mice also showed increased apoptosis in the DG. This supports the concept of PIANP as an important modulator of adult hippocampal neurogenesis and offers first clues as to the mechanisms of its clinical loss-of-function symptoms. Further research is necessary to investigate possible connections between PIANP and the regulation of adult neurogenesis and its role in memory formation and learning.

P1-N29

Chemokine production by microglia mediates blood derived-monocytes trafficking in neuroinflammation in mice

Mei Ying Huang[2], Joohyun Park[2], Jong Youl Kim[3], Chemokine Production By Microglia Mediates Blood Derived-monocytes Trafficking In Neuroinflammation Won Taek Lee[3], **Jong Eun Lee[1]**
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Microglia and recruited macrophages play major roles in neuroinflammation. We explored how these cells affect counterpart's polarization and infiltration and revealed some chemokines and receptors can be important modulators of the interaction.
We set up a undirect co-culture system of BV2 (microglia cell line) and THP-1 (monocyte cell line). BV2 or THP-1 cultured in M1, M2 conditioned media. Transwell migration was used for assessment of THP-1 infiltration and BV2 migration. M1/M2 conditioned media of BV2 and

THP-1 were assessed by proteome profiler array to find target cytokine and chemokine. The expression of chemokine receptors in THP-1 was confirmed by western blotting. 8 weeks old male, CCR2::RFP C57BL/6J mice were obtained from Jackson Laboratories (Bar Harbor, ME) and followed by LPS injection (i.c.v). All animal experiments were approved by the Institutional Animal Care and Use Committee (IACUC) at Yonsei Laboratory Animal Research Center (YLARC). Mice were anesthetized by amixture of zoletil (100 mg/kg) and xylazine (rompun, 10 mg/kg).

THP-1 expressed CD206 when cultured in M2 conditioned media of BV2, and also got increased the infiltratory ability. Several chemokines such as CCL2, CCL3, CCL4 and CCL5 were significantly increased in conditioned media of BV2 while their receptor CCR4, CCR5 shows high expression in THP-1. Antagonists of CCR2, CCR4 and CCR5 significantly reduced the infiltration ability of THP-1 to BV2 M2 conditioned media. CCR2 positive cells in mouse cortex were significantly increased after LPS injection, when CCR4, CCR5 antagonist co-injection can reduce the number of infiltrated CCR2 positive cells.

Chemokine receptors CCR4, CCR5 can be strong candidates of target protein in new therapeutic strategies to acute brain inflammation by modulating the functions of microglia and monocytes.

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P1-N30

The nerve injury increases the expression of galanin in the trigeminal ganglion of Wistar rats

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Galanin (GAL) is expressed by small sensory neurons of the spinal and trigeminal nerves and is associated with nociceptive transduction. Previous studies have demonstrated the sciatic nerve transection increases the synthesis of GAL in the dorsal root ganglion. However, little is known about the effect of the nerve injury on GAL in the trigeminal ganglion (TG). In this study, immunohistochemistry for GAL was performed on the TG after transection of the infraorbital (ION) and inferior alveolar nerves (IAN).

Transection of the left ION and IAN was conducted on the male Wistar rats under the deep anesthesia with a mixture of medetomidine (0.15 mg/Kg), midazolam (2.0 mg/Kg) and butorphanol (2.5 mg/Kg) (i.p.). The left nerves were exposed through the incision of the skin and subcutaneous layer and transected using microscissors. Sham-operated animals were as control groups, in which the left nerves were exposed without nerve injury. At 1 week after the operation, rats were deeply re-anesthetized with isoflurane and perfused through the left ventricle with Zamboni fixative. The materials were frozen-sectioned at 8 µm thickness, and stained for GAL by an ABC method. All the procedures were approved by the Animal Research Control Committee of Tohoku University.

After ION or IAN transaction, small GAL-positive neurons increased and large GAL-positive neurons appeared within the ipsilateral TG. Small neurons were intensely stained and the reaction products were detected throughout their cytoplasm. Large neurons were lightly stained and the reaction products showed granular appearance within the cytoplasm. As a result, a 2-3 fold increase was detected in the injured TG. The present findings suggest that GAL may be associated with the change of neuronal activity, degeneration and regeneration of their nerves and pain transduction in axotomized sensory neurons within the TG.

P1-N31

Mechanism of leptin regulating proliferation and differentiation of rat embryonic neural stem cells in vitro

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Leptin has been reported to contribute to neural regeneration, angiogenesis and neurotrophy afterneural injury. However, the specific mechanism remains to be further explored. Here, pregnant Sprague-Dawley rats were sacrificed on embryonic day 14.5 after intraperitoneal injection of pentobarbital sodium. Whole brain of embryos were removed, All animal work were approved by the Animal Ethical Committee of School of Basic Medical Science, Xi'an Jiaotong University.NSCs were isolated from cerebral cortex of embryos and cultured with DMEM/F12 serum free medium for 5~7 days before subculture. Cells on Passage 2 or 3 were then treated with different concentration of leptin (25, 50, 100ng/mL) .
CCK-8 assay, growth curve, FACS and immunostaining with Ki67, GFAP and β-TublinⅢ were used to investigate the survival , proliferation and differentiation of NSCs, respectively. Signalling pathways related to NSCs behavior wered detected by Western blot.
Results showed that 25-100ng/mL leptin significantly promoted the viability and proliferation of NSCs in a concentration-dependent pattern ($p<0.05$). Consistently, significant increase of the number of ki67+ cells and higher proliferation index were detected after treated with leptin ($p<0.05$). However, no significant difference regarding the apoptosis was found ($p>0.05$). Increased β-TublinⅢ+ cells was also detected ($p<0.05$). No significant difference in GFAP+ cells was found ($p>0.05$). the expression of p-ERK/ERK increased and p-STAT3/STAT3 decreased significantly ($p<0.05$). These results suggested that leptin promoted rat embryonic NSCs survival, proliferation and neuronal differentiation in vitro. MAPK and JAK-STAT3 signalling pathways play important roles. Specific inhibitors of above signaling pathways were applied and the further study on NSCs biological behavior are currently ongoing in our lab.

P1-N33

A clinical investigation of the anatomy of the proximal anterior cerebral artery and its association with anterior communicating artery aneurysm

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Approximately 90% of cerebral aneurysms occur in blood vessels forming the anterior circle of Willis; and the anterior communicating artery (ACoA) is the single most frequent site for aneurysm rupture, accounting for approximately 40% of aneurysmal subarachnoid haemorrhage. Neurosurgeons and anatomists suggest that there is a possible anatomical risk factor for aneurysm formation in this location, as unilateral hypoplastic A1 segments are present in 85% of ACoA aneurysms. This study aimed to describe the anatomy of the proximal anterior cerebral artery (ACA) (defined as A1 and A2 segments) in a cohort of patients with ACoA aneurysm. A total of 75 digital subtraction angiograms were analysed (Ethical Clearance: BE652/18). Unilateral hypoplastic A1 segments were found in 56% of cases (R: 33.3%; L: 22.6%). Mean diameters and lengths of non-hypoplastic A1 segments were 1.73mm and 13.30mm on the right, respectively and 1.81mm and 12.35mm on the left, respectively. The A2 segments were present in all cases and had a mean diameter and length of 1.66mm and 25.23mm on the right, respectively; and 1.64mm and 25.51mm on the left, respectively. In the intraoperative management of ACoA aneurysms, aneurysm projection is an important consideration when planning dissection because the aneurysm creates a surgical blind spot that may conceal a critical artery or part of the aneurysm. In this study the projection was classified as Anterior (42.67%), Posterior (5.33%), Superior (40%) and Inferior

(12%). ACoA aneurysms are highly complicated given the propensity of the proximal ACA to anatomical variability; therefore, the morphometry and morphology of A1 and A2 segments has importance to the endovascular surgeon during intraoperative management of ACoA aneurysms. Additionally, this study highlights the association of ACoA aneurysm and unilateral A1 hypoplasia as unilateral dominance increases shear stress on the wall of the ACoA which may predispose it to aneurysm formation.

P1-N34

α-DB knock-out mice: a new possible model for the study of Vascular Dementia?

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Vascular dementia (VaD), the second most common form of dementia, has no effective therapies. A lack of adequate animal models has impeded progress in understanding the pathophysiology and mechanistic changes that occur in VaD. In VaD the small vessels of the brain fail to deliver blood and to eliminate waste efficiently. Normally, waste products are removed from the brain along cerebral vascular basement membranes (BM), in the intramural periarterial drainage pathway. Integrity of this pathway is reliant on the anchoring of the BM to surrounding astrocyte endfeet. This is, in part, regulated by the protein α-dystrobrevin (α-DB), a key component of the dystrophin-associated protein complex. Alterations to this complex have been shown to alter the cerebrovasculature in mouse models of Duchenne's muscular dystrophy, but this has not been considered as a potential model for VaD. Here, we assess, using high resolution transmission electron microscopy (TEM) if α-DB deficient (α-DB-/-) mice can be used to model the vascular changes seen in VaD by performing a detailed ultrastructural analysis of the neurovascular unit (NVU).
Briefly, α-DB-/- mice and littermate controls were terminally anaesthetised and perfused with fixative for TEM. Dissected brains were prepared for TEM following in-house optimised protocols. Changes in the NVU were assessed by measuring alterations in the composition of the endothelium, intramural cells and BM, in small vessels from both grey and the white matter.
We found that the composition of the NVU was altered in both grey and white matter in α-DB-/- mice, with a significant thickening of the BM. We also observed a significantly thinner endothelium, but only in the grey matter.
α-DB-/- mice show changes to their BM and may provide a possible model of VaD. However, further research is needed to elucidate whether these mice are a valid model, such as drainage and behavioural studies.

P1-N35

The Effects of Aging on Tactile Discrimination and Tactile Memory on Hand

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Tactile discrimination considers the ability to distinguish two points on skin while touching it. This forms an extremely important assessment in patient with nerves injuries and in parietal lobe disorders. Tactile memory represents the ability of memory using the exact touched point on the body, as well as recognizing objects only with sense of touch, without watching it. The aim of this study was to determine the impact of aging on tactile discrimination and memory on skin of forefinger on both hands.
Research was implemented on 60 participants (30 students and 30 beneficiaries of Gerontology center of Novi Sad). Approval from the Institutional Ethics committee was taken for the study. First, we measured two-point discrimination by using Disc-Criminator. Then we examined tactile memory by using markers and Digital Vernier Caliper (0-150 mm). The task for participant was to touch their index finger with their eyes closed at the same spot where the

examiner has touched them. We measured the distance between two spots in millimetres.
Young participants showed statistically significant higher ability of tactile discrimination compared to the elderly participants on both hands ($p<0.01$). Elderly participants showed statistically higher ability of tactile memory on both hands compared to the young participants ($p<0.01$).
Aging leads to decrease in the ability of tactile discrimination, and increase in the ability of tactile memory on forefinger of both hands.

P1-N36

Neuronal activation after Sexual Behavior in the Sagittalis Nucleus of the Hypothalamus in rats

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During extended observation of estrogen receptor (ER) α-immunoreactive neurons in the hypothalamus, we previously identified a novel nucleus, the Sagittalis Nucleus of the Hypothalamus (SGN), in the interstitial area between the arcuate nucleus and the ventromedial hypothalamic nucleus in rats. The SGN exhibits male-biased sexual dimorphism in its volume and cell count, and estrous cycle related variations in ERα-immunoreactive neuronal number. These characteristics suggest a contribution of the SGN to sexually differentiated brain function in both sexes. In this study, we examined correlation of the SGN with sexual behavior. Immunohistochemical staining of c-Fos, a marker of neuronal activity, revealed that a significant increase in the number of c-Fos-positive neurons was seen following administration of an estrus-inducing dose of estrogen and progesterone in female rats. In male rats, c-Fos-positive cell number in the SGN was elevated with only exposure to chemosensory cues of estrous females and significantly increased after the first mount. These findings may indicate that neurons in the SGN are associated with early phase of sexual behavior, including sexual arousal, in both males and females.

P1-N37

NT-3/TrkC signaling regulates dendritic bundle formation in the rat granular retrosplenial cortex

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The rat granular retrosplenial cortex (RSCg) are a useful model system for investigating dendritic bundles. The RSCg has prominent apical dendritic bundles in layer (L) 1, which derive from callosally projecting pyramidal neurons in L2. We had investigated the mechanisms of bundle formation, focusing on L2 bundles, in the rat RSCg. By using microarrays, we first searched for genes highly and specifically expressed in RSCg L2 before bundle formation on postnatal day 3 (P3). This screening identified neurotrophin-3 (NT-3) as highly and specifically expressed in the RSCg L2 at P3. To test the importance of NT-3–mediated events in bundle formation, we used in utero electroporation to overexpress NT-3 in cortical areas where L2 bundles are normally absent. This intervention in fact successfully induced apical dendritic bundling in the barrel cortex and adjacent regions. The controlled ectopic induction of dendritic bundles identifies a new role for NT-3, but it remains unclear how the NT-3 signals are transduced into the L2 neuron and regulate dendritic bundle formation.
Here, we investigate mechanisms of bundle formation via NT-3. We show that the NT-3 receptor TrkC has important roles in bundle formation in the RSCg L2. We induce the expression of a dominant negative variant of TrkC (DN-TrkC), which lacks the tyrosine kinase domain, by in utero electroporation in the RSCg. The RSCg dendritic bundle with DN-TrkC presented induced malformation in which the bundle become wider, especially within its distal tufts. In addition, single-cell labeling and further morphological analysis revealed that inhibition of TrkC signaling induced ectopic dendritic branching. These results suggest that NT-3/TrkC signaling shape dendritic bundles by regulating

the dendritic branching of individual L2 pyramidal neurons in the RSCg.
All animal experiments were conducted in compliance with the guide for animal experiments, which is established by Teikyo University.

P1-N40

Spectral Confocal Reflectance Microscopy can Quantify Myelin and Myelin Debris in a Murine Model of Demyelination and is Compatible for use on Post-Mortem Human Tissue

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High throughput and accurate quantitation of changes to compact myelin in pre-clinical models of demyelinating disease such as Multiple Sclerosis is critical in order to develop novel therapies that target myelin repair. Traditional quantitation has only been possible via Electron Microscopy (EM), which has significant limitations in terms of throughput and sampling. As demyelination is rarely uniform, sampling enough tissue to capture disease related changes using EM is, in many instances, virtually impossible. Here, we have utilized Spectral Confocal Reflectance (SCoRe) microscopy, a novel technique that takes advantage of the optically reflective properties of compact myelin, to quantify the extent of myelin pathology in the murine cuprizone model of CNS myelin injury (project approved by Florey AEC #16-095-UM). SCoRe imaging can detect a significant reduction in the optical signal within the corpus callosum as early as 4-weeks post cuprizone challenge, indicating the myelin structure is pathologically altered. A significant increase in the amount of myelin debris, a well-established and potent inhibitor of remyelination, is observed throughout the course of disease. Combining SCoRe with immunohistochemistry, we observe that ~10% of the compact myelin debris is colocalized within IbA1+ microglia, irrespective of time point or region analysed, suggesting myelin debris clearance is consistent throughout the corpus callosum. This identifies SCoRe as an effective tool to discriminate between and quantify demyelination and myelin debris dynamics in the cuprizone model, with great potential for utility in other model systems. Finally, we also show SCoRe microscopy is compatible for use on post-mortem human tissue, demonstrating regional differences in compact myelin between internal capsule, sub-cortical white matter and cortical grey matter (project approved by UoM HREC #1850981.1). This technique has the capacity to improve our understanding of compact myelin changes both during disease and in normal human ageing.

P1-N41

Nrf2 overexpression in GFAP-astrocytes decreases oxidative stress and increases reactive astrocytes after ischemic stroke in mice

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Stroke (cerebral ischemia) is a leading cause of death and disability. Two key pathophysiological mechanisms of ischemic brain damage are inflammation and oxidative stress. The transcription factor Nrf2 upregulates a battery of over 200 antioxidant and anti-inflammatory proteins. In vitro studies show that the neuroprotective effects of Nrf2 are dependent on glia, notably astrocytes. GFAP-Nrf2 mice which overexpress Nrf2 specifically in astrocytes are

significantly more resistant in vivo to mitochondrial inhibition. Moreover, preliminary studies show that GFAP-Nrf2 mice have decreased infarct volume compared to wild-type mice after ischemic stroke, suggesting that Nrf2 upregulation in astrocytes may have neuroprotective effects.

In the present study, we hypothesized that the neuroprotective effect observed in GFAP-Nrf2 mice after acute ischemic stroke was due to decreased oxidative stress and inflammation. The aim was to characterize the extent of oxidative stress (3-nitrotyrosine) and gliosis (GFAP-reactive astrocytes and Iba-1-microglia/macrophages) with immunostaining following acute ischemic stroke (60 mins of middle cerebral artery with 23-hour survival; general anaesthesia with 5% isoflurane, 30% oxygen and 70% nitrous oxide) or sham surgery in GFAP-Nrf2 mice and wild type (C57Bl/6J) mice (n= 7-15/group). All experiments were conducted under the permission and regulations of the UK Home Office Animal Act 1989.

Ischemic stroke increased oxidative stress, assessed with 3-nitrotyrosine, however, there was a significant reduction in oxidative stress in GFAP-Nrf2 mice compared with WT mice. Reactive astrocytes were increased after ischemic stroke in the peri-infarct region and significantly increased in GFAP-Nrf2 mice compare to their WT counterparts. Ischemic stroke did not alter microglia/macrophages in GFAP-Nrf2 mice compared with WT mice.

Therefore, Nrf2 overexpression in GFAP-astrocytes has neuroprotective effects due to the alleviation of oxidative stress following an ischemic stroke. There was no evidence that this neuroprotection was caused by reduced inflammation, however there were increased reactive astrocytes GFAP-Nrf2 mice following ischemic stroke.

P1-N42

The paralaminar nucleus of the amygdala: a puzzle piece for stress regulation in major depressive disorder

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Embedded beneath the lateral, basal and cortico-amygdaloid regions of the amygdala is the paralaminar nucleus (PL), a poorly understood structure that has evolved to be relatively larger in humans and non-human primates. Studies show that it has dense mood regulatory serotonergic connections and indicate it to be a site for amygdalar neuroplasticity.

Until recently, neuroimaging was unable to visualise this enigmatic nucleus in vivo. The purpose of this study was to investigate the involvement of the PL in Major Depressive Disorder (MDD) and evaluate whether the cortisol awakening response (CAR), a measure of HPA axis function, was related to its volumetrics.

20 healthy and 15 depressed subjects were scanned using high-resolution T1 magnetic resonance imaging at Trinity College Institute of Neuroscience. Paralaminar volumes were generated using state-of-the-art automated amygdalar segmentation in FreeSurfer-6.0. Participants also provided three-morning salivary cortisol samples (0, 30, 60 mins after waking). The CAR was calculated using two well-defined calculations; area under the curve with respect to ground and increase (AUCg and AUCi respectively). Ethics for this study was granted under the Tallaght hospital REC.

Results showed a smaller left PL in MDD and that which inversely correlated with AUGi. This indicates a smaller left PL may impact the normal cortisol response to waking, a known neuroendocrine disturbance in the disorder. The relationship between the AUCg and the right PL in MDD also showed that total cortisol output may be associated in right PL volumes in MDD. These results were consistent with the hypothesis of cortisol oversecretion in MDD and previous findings of larger right amygdalae in MDD and

right-sided amygdalar affective dominance for negative emotions.
In summary, this study suggests a role for this nucleus as a potential nexus in the regulation of stress in MDD.

P1-N43

The Effects of Syringic Acid on Learning & Memory After Chronic Deltamethrin Exposure in Wistar Rats

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Recent developments in the field of deltamethrin (DTM) exposure have led to a renewed interest in alternative antioxidant therapy against toxicity mechanism of DTM. The aim of present study was to evaluate the neuroprotective role of syringic acid (SA) after chronic DTM toxicity on rat hippocampus by biochemical, histopathological, immunohistochemical analysis and learning & memory tests.
In this study sixty four adult male Wistar rats were divided into 4 groups consisting of control (I) , deltamethrin (II), deltamethrin + syringic acid (III), syringic acid (IV). [treated with 25 mg/kg doses of syringic acid after deltamethrin exposure with 1.28-1.35 mg / kg doses by oral gavage daily for 2 months]. Spatial and working memory were evaluated by open field and radial arm maze tests.Total antioxidant capacity, reactive oxygen and nitrogen species, glutamate/glutamine expressions and dopamine levels of hippocampus were also determined.
Syringic acid (SA) improved spatial & working memory and locomotor activity against DTM. SA and SA+DTM led to increase total antioxidant capacity, while significantly reduced the oxidative stress and apoptosis (CA1/CA3 subfields) of the hippocampus. It had no significant effects on the glutamate/glutamic acid expression of the hippocampus but enhanced the dopamine levels ($p<0,05$).A positive correlation was found between dopamine and learning.
The study has shown that SA therapy could increase short and long term memory while decreasing oxidative stress and apoptosis in hippocampus after chronic DTM application. An additional important finding to emerge in this study is SA may lead to improve learning and memory with stimulation of dopamine expression.

P1-N44

Activation of ϱ7nAChR alleviates Aβ-induced anxiety- and depressive-like behavior in mice by regulating ERK signaling pathway

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People with Alzheimer's disease often undergo anxiety, depression and other affective disorders. Previous studies have shown that ϱ7nAChR has protective effects against Aβ-induced neurotoxicity. However, the effects of ϱ7nAChR on Aβ-induced anxiety- and depressive-like behavior remain little understood and whether ϱ7nAChR exert its function through regulating MAPKs pathways remains elusive. We examined the effects of ϱ7nAChR and MAPKs pathways on Aβ-induced anxiety-like and depression-like behaviors and explored their relationships. Elevated plus maze, open field and forced swim tests were performed to ascertain anxiety- and depressive-like behavior. Protein levels of 5-HT1AR, 5-HT2CR, ϱ7nAChR, ERK, and pERK in the amygdala were examined by western blotting or immunostaining. Here, our study found that Aβ

induced anxiety and depression as is shown in open filed, elevated plus maze and forced swimming tests. Activation of ϱ7nAChR or inhibition of ERK pathways showed significant antidepressant and anxiolytic effects on Aβ-induced depression-like behavior. Moreover, Aβ significantly decreases level of 5-HT1A receptor but increases level of 5-HT2C receptor in the amygdala, which area is related to anxiety and depression. Treatment with ϱ7nAChR agonist PNU282987 or ERK inhibitor U0126 could reverse Aϱ-induced 5-HT1A and 5-HT2C changes. In addition, activation of ϱ7nAChR could downregulate ERK signaling pathway in the amygdala of Aβ1-42-injected mouse. These results provide new insight into the mechanism for ϱ7nAChR in Aβ-induced depression- and anxiety-related symptoms through regulation of serotonin receptors and potential cross-effects with the ERK1/2 signaling pathway. Our data indicate that ϱ7nAChR is involved in the protective effects against anxiety and depression in Alzheimer's disease.

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P1-N45

Resveratrol regulates synaptic plasticity-related molecules in the rat cerebral cortex after bilateral common carotid artery occlusion and reperfusion

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This study investigates the putative role of the polyphenol resveratrol (RVT) in driving neuroprotective mechanisms of cerebral homeostasis during the oxidative stress induced by bilateral common carotid artery occlusion, and RVT's ability to preserve the neuronal structural integrity. Frontal and temporal-occipital cortices were examined in male adult Wistar rats, randomly subdivided in two groups, sham-operated and submitted to BCCAO/R. Experimental protocols conformed to guidelines of the Animal Ethics Committee of the University of Cagliari. Six hours before surgery, half the rats were gavage fed a dose of RVT (180 mg•kg−1 in 300 µL of sunflower oil as the vehicle), while the second half received the vehicle alone. An intraperitoneal injection of Equithesin was used as anesthesia prior to surgery. By means of western blot and immunohistochemistry, it has been examined whether a single dose of RVT modulates the plasticity-related markers brain-derived neurotrophic factor (BDNF), the tyrosine kinase trkB receptor, Polysialilated-Neural Cell Adhesion Molecule (PSA-NCAM), and Activity-regulated cytoskeleton-associated (Arc) protein in the cerebral cortex after BCCAO/R. In the frontal cortex of BCCAO/R vehicle-treated, BDNF and PSA-NCAM decreased, while trkB increased. RVT pre-treatment elicited an augmentation of all the examined markers in both the sham-operated and BCCAO/R rats. No changes occurred in the temporal-occipital cortex. The results highlight a role for RVT in modulating neuronal plasticity through the BDNF-trkB system and upregulation of PSA-NCAM and Arc, which may provide both trophic and structural local support in the dynamic changes occurring during the BCCAO/R. Results obtained meet previous data showing that RVT pre-treatment reverses the BCCAO/R-induced decrease of the structural membrane lipid docosahexaenoic acid and upregulates levels of pre- and post-synaptic proteins. Altogether, the present findings suggest that dietary supplements such as RVT are effective to preserve the tissue potential to engage plasticity-related events and control the functional response to the hypoperfusion/reperfusion challenge.

P1-N47

Changes in Astrocyte Cell Populations in the Embryonic Rat Spinal Cord Following Maternal Immune Activation

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Maternal immune activation (MIA) during pregnancy has been suggested to influence neurodevelopment in offspring. Specifically, MIA has been implicated as a risk factor for multiple neurodevelopmental conditions, including schizophrenia, autism and epilepsy. The aim of this experiment was to test this hypothesis; investigating the effect of MIA on astrocytic behaviour in offspring using immunofluorescent staining of the astrocyte marker, Glial Fibrillary Acidic Protein (GFAP) in the spinal cord. By detecting changes in astrocyte expression, it could be established that MIA antagonises the developing CNS, causing abnormalities and therefore may be a risk factor for neurodevelopmental disorders.

A time mated rat model was used for the experiment: to induce an immune response, animals received a single intraperitoneal injection of either 100µg/kg LPS (lipopolysaccharide) or saline at set gestational points, embryonic day (E)12 or E16. After maternal sacrifice, offspring were delivered by laparotomy. Both groups of offspring were sacrificed and had their tissues processed at postnatal day 14 (P)14. Animal procedures were carried out in accordance with Republic of Ireland Department of Health and Children licenses compliant with the Institutional Animal Care and Use Committee, complied with the European Council Directive (86/609/EEC).

Astrocytes were stained, imaged using confocal microscopy and analysed for significant changes between immune-activated and control groups. Immunofluorescent staining was performed and sections were imaged using epifluorescence. 440 images were taken - from five regions on each sample, including grey and white matter. These were analysed in image analysis software, fluorescence intensities were measured and recorded blind.

Statistical analysis found no statistical significance and a high level of variance in this instance. This indicated that more experimentation is required, using larger sample sizes to minimise variance. Additionally, this experiment was limited to P14 for tissue processing, a selection of times may better represent the neurodevelopmental period, yielding more informative results.

P1-N49

The trigeminal ganglion in a spinal muscular atrophy mouse model

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Spinal muscular atrophy is a neurodegenerative disease and induces cell death of motor neurons in the spinal cord, which leads to muscle atrophy. This disease is caused by deficiency of survival motor neuron (SMN) protein. In the spinal nervous system, loss of SMN has little or no effect on sensory neurons. The number of sensory neurons was similar in the dorsal root ganglia of wildtype and Smn-/-;SMN2 mice. However, little is known about the effect of SMN deficiency on sensory neurons in the trigeminal nervous system. In this study, we investigated the number and cell size of sensory neurons in the trigeminal ganglion (TG) of Smn-/-;SMN2 mice.

Five C57BL/6 wildtype and 5 Smn-/-;SMN2 mice at postnatal day 5 were used in this study. These animals were deeply anesthetized with tribromoethanol (Avertin) and transcardially perfused with 4% paraformaldehyde in 0.1 M phosphate buffer (pH 7.4). The TG was dissected, frozen-sectioned at 8 µm thickness and processed for Nissl stain.

By a gross anatomical study, the TG in wildtype mice was large and had 2 thick nerves, the opthalmo-maxillary and mandibular nerves. In Smn-/-;SMN2 mice, the length, width and thickness of the TG was severely decreased and the 2 nerves were thin. At the microscopic level, numerous sensory neurons were detected in the TG of wildtype mice. These neurons mainly had small and medium-sized cell bodies. However, the loss of SMN decreased the number of sensory neurons in the TG. Many TG neurons with small to large cell bodies were absent in Smn-/-;SMN2 mice. These findings suggest that SMN deficiency impacts the overall size range of TG neurons.

SMN protein may be essential for survival of sensory neurons in the TG.

P1-N50

Palisade Endings in Cat Extraocular Muscles Develop Postnatally in a Heterochronic Sequence

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Increasing interest is attributed to proprioceptive innervation of extraocular muscles (EOMs) for the development of binocular vision. Classical proprioceptors (muscle spindles, Golgi tendon-organs) are absent in EOMs of most mammals. Instead, EOM-specific palisade endings are regularly found in frontal-eyed but not in lateral-eyed species. Palisade endings exhibit structural features of sensory Golgi tendon-organs, but are cholinergic and originate from motor nuclei.
We analyzed postnatal maturation of palisade endings in a frontal-eyed species. Cats of different ages (P0-adult, obtained from the animal house of the Universidad de Córdoba) were used, whole mount preparation of rectus muscles triple-immunolabelled, and analyzed with CLMS. Labelling included antibodies against neurofilament (axons), anti-synaptopysin (nerve terminals), anti-growth-associated-protein43 (GAP43, developing axons), anti-choline-acetyltransferase (cholinergic neurons), and α-bungarotoxin (acetyl-choline receptors).
Results show that palisade endings develop postnatally. In each rectus muscle they undergo the same development but in a heterochronic sequence and to different final densities. Around birth only in the medial and inferior rectus, precursors of palisade endings are found. At P8, immature palisade endings appear first in the medial rectus and two weeks later in the inferior rectus. At P22 there are still precursors in the lateral and superior rectus. At P45, palisade endings are found in all rectus muscles and at P95 they are as complex as in adult animals. The number of palisade endings is highest in the medial rectus. GAP43 expression decreases with age and is nearly absent in adult animals. Axons forming palisade endings establish multiple motor contacts along the muscle fibers.
Cats open their eyes 7-10 days after birth and later develop a complex three-dimensional visuomotor climbing- and jumping-behavior depending on accurate fine tuning of binocular vision. Our findings indicate that palisade ending development correlates with visuomotor-behavior development and that palisade endings play an important role for convergent eye movements in frontal-eyed species.
All procedures with animals have been evaluated and approved by the ethics committee of the Universidad de Sevilla and the local government to strictly adhere to the Spanish legislation for the use and care of laboratory animals (R.D. 53/2013, BOE 34/11370-421, 2013).

P1-N51

Anatomical variations of the oculomotor nerve

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The oculomotor nerve enters the orbit via the superior orbital fissure and innervates extrinsic eye muscles that enable most movements of the eye and that raise the eyelid. The nerve also innervates the intrinsic eye muscles that enable pupillary constriction and accommodation. The aim of the study was to evaluate its course and divisions.
50 orbits taken from cadavers were dissected. The orbital content was removed en bloc. The lateral rectus muscle was detached from its insertion and reflected. After removal of the orbital fat, the oculomotor nerve and its branches were visualized and traced.
The superior branch of the oculomotor nerve (superior division), is the smaller branch of the nerve. It passes medially over the optic nerve and sends sub-branches to the superior rectus and

levator palpebrae superioris muscles. The inferior branch of the oculomotor nerve (the inferior division), the larger, divides into three sub-branches. One of them passes beneath the optic nerve to the medial rectus. Another, to the inferior rectus. The third and longest sub-branch (the nerve to the inferior oblique) runs forward between the inferior rectus and lateralis to the inferior oblique muscle. All these branches enter the muscles on their ocular surfaces, with the exception of the nerve to the inferior oblique, which enters the muscle at its posterior border. In two cases the nerve to the inferior oblique pierced the inferior rectus muscle. In one case the inferior division gave double motor root to the ciliary ganglion.
The territory of innervation of the oculomotor nerve seems to be constant.
Ethical approval Nr RNN/338/17/KE (21.11.2017).

P1-N52

Anatomical variations of the parasympathetic (motor) root of the ciliary ganglion

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The ciliary ganglion is a parasympathetic ganglion located just behind the eye in the posterior orbit. It has the shape of a four-sided, gray-pink plate with a length of about 2mm. It lies in the depth of the orbit, approximately on the border of its posterior and middle one-third part, on the lateral surface of the optic nerve, medially from the lateral rectus muscle. Motor sympathetic and parasympathetic neurons, and sensory neurons pass through this ganglion. After leaving the ganglion the parasympathetic preganglionic axons are switched to postganglionic axons which run in the short ciliary nerves and innervate two eye muscles: the sphincter pupillae and the ciliaris muscle. The aim of the study was to evaluation of the course of the parasympathetic (motor) root of the ciliary ganglion.
20 orbits taken from cadavers were dissected. The orbital content was removed en bloc. The lateral rectus muscle was detached from its insertion and reflected. After removal of the orbital fat, the ciliary ganglion was visualized and the parasympathetic (motor) root of the ganglion was traced.
The single motor root was observed in 17 out of 20 dissected orbits, and in most cases, it arose from the inferior division of the oculomotor nerve. In one case the double motor root arose from the inferior division of the oculomotor nerve. In two cases two motor roots were observed – the first arising from the inferior division of the oculomotor nerve and the second (accessory) arising from the superior division of the oculomotor nerve.
In most cases the single motor root of the ciliary ganglion arise from the inferior division of the oculomotor nerve. However, some anatomical variations of this root may be observed.
Ethical approval Nr RNN/338/17/KE (21.11.2017).

P1-N53

The effects of surgical menopause on striatal circuits in rats

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Estrogen is believed to have a neuroprotective effect and known to regulate the dendritic spines on hippocampal and cortical pyramidal neurons. Interestingly, we found estrogen depletion in rats reduced the dendritic spines on primary somatosensory but increased those on somatomotor cortical pyramidal neurons, suggesting that estrogen has differential cortical actions. Since the large subcortical structure basal ganglia also regulate movement, this prompted us to investigate how estrogen affects the striatum of the basal ganglia in female. Ovariectomy, surgical menopause, in rats for 6 weeks increased striatal glutamatergic postsynaptic density protein PSD95, suggesting enhanced excitatory drive to striatum. Intracellular dye injection of retrograde tracer-identified striatal medium spiny neurons (MSNs) show that ovariectomy increased dendritic spines on direct-pathway MSNs while having no obvious effect on indirect-pathway MSNs, suggesting

skewed excitatory enhancement to the former. Western analyses show ovariectomy increased striatal type 1 but reduced type 2 dopamine receptors without affect tyrosine hydroxylase level, again flipping over direct and indirect pathway weights. At the same time striatal choline acetyltransferase was reduced, suggesting decreased cholinergic presynaptic inhibition of dopamine release so that the altered dopamine's actions via direct and indirect pathways were accentuated.

In summary, our results showed that in adult female, estrogen depletion such as following menopause rewired the basal ganglia circuits. This could have complicated the movement disorders in female Parkinson's patients. (All animal experiments were approved and followed institutional guides. The study was supported by grants from the Ministry of Science and Technology of Taiwan and TCU)

P1-N54

Ultrastructural Effects of Targeted TDP-43 Expression in the Upper Motor Neurons of Rats by Systemic Delivery of Adeno-Associated Virus Vectors

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Trans-acting RNA/DNA binding proteins regulate splicing, polyadenylation, stability and transport in neurons. Hyper-phosphorylated and ubiquitinated TDP-43 (TarDNA-binding protein-43) deposits act as inclusion bodies in patients with the motor neuron diseases. This study aimed to investigate ultrastructural alterations in the upper motor neurons of rats following targeted delivery of TDP-43 by adeno-associated virus (AAV) vectors.

The control plasmid is comprised the gene sequences for replication and structural proteins, enhanced green fluorescent protein (eGFP), and the polyadenylation signal driven by Ubiquitin C-Terminal Hydrolase L1 promoter between two inverted terminal repeats, while the transgene plasmid is also included wild-type TDP43 sequences. Sprague-Dawley rats were obtained from the breeding colony of Animal Care Facility. Experimental procedures were performed in accordance with protocols approved by the Institutional Animal Usage Committee of Eskisehir Osmangazi University (Protocol #504-1). After hypothermic anesthesia of animals (n=3 for each group) at postnatal day 3, facial vein was used for systemic injection of AAV vectors. Animals were sacrificed by intra-cardiac perfusion under ketamine/xylazine anesthesia on postnatal day 30. Sections from the motor cortex were post-fixed in buffered 2% osmium tetroxide and stained with 1% uranyl acetate. 70nm-thin sections were collected on grids and counterstained with uranyl acetate and 0.2% lead citrate to process for TEM examination.

Initial stages of structural defects were seen in the nuclear membrane, where some segments of the membrane were either convoluted or discontinued. Numerous kinks and groves were visible in the nuclear membranes in contrast to normal appearance of smooth and round membranes in control animals. Disorganized inner cristae within the mitochondrial matrix and swollen vacuoles in the dendrites of neurons were noticeable in animals injected with TDP-43 vectors.

Collectively, our ultrastructural data revealed that targeted TDP-43 expression compromises the integrity of upper motor neurons by causing cellular degeneration in specific organelles.

P1-N55

Localisation and Functional Role of MAGI-1 in Rat Neurons

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MAGI (membrane associated guanylate kinase inverted) proteins belong to the MAGUK-family (membrane associated guanylat kinase) of synaptic scaffolding proteins. They consist of three members: MAGI-1, MAGI-2 (also known as S-SCAM) and MAGI-3. Though MAGI-2 function in the brain has been studied intensively, little information about MAGI-1 function in neuronal tissue is available. In this study we analyzed the localisation and functional role of MAGI-1 in primary cultured rat hippocampal neurons. Transfection of recombinant MAGI proteins and immunofluorescent analysis in immature neurons revealed diffuse distribution of MAGI-1 and -2 in the cell body and neurites at early DIV stages of the culture system. Synaptic localisation of MAGI-2 was observed at DIV 5 while MAGI-1 was enriched at synapses at later stages of culture development. Both MAGI proteins localise at inhibitory and excitatory synapses. Further, MAGI-2 knockdown neurons display a severe loss of synapses. This phenotype was rescued by increasing MAGI protein levels with recombinant MAGI-1 in MAGI-2 knockdown hippocampal neurons. These results suggest that MAGI-1 is competent to substitute for MAGI-2 function during synapse formation while the transport mechanism of these proteins to synaptic sites is temporally different.

P1-N58

The effect of Robo4 on angiogenesis, proliferation and migration in glioma

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To observe the expression and function of Robo4 on human umbilical vein endothelial cells and glioma cells. Firstly, Robo4 was analyzed in the GEO database; then, the expression changes of Robo4 were detected in glioma cell lines, separated human umbilical vein endothelial cells, glioma and human umbilical vein endothelial co-culture cells. The lentivirus with over expression of Robo4 gene was transfected into human umbilical vein endothelial cells, then CCK-8 experiment and Cell scratch experiment were respectively used to detect the effect of Robo4 on the proliferation and migration of endothelial cells. The effect of glioma culture solution on the tube-forming ability of endothelial cells was observed by Matrigel matrix gel tube experiment. All experiments were approved by the Medical Ethics Committee of Binzhou Medical University. According to the analysis of biological information, Robo4 was the differentially expressed gene in tissue angiogenesis. The differentially expressed of Robo4 gene was significantly enriched in angiogenesis, regulation of cell proliferation and migration, tumor pathway, axon guiding pathway and other aspects. Compared with the endothelial cells cultured in normal medium, the expression of Robo4 was significantly down-regulated ($p<0.05$) than the glioma and human umbilical vein endothelial co-culture group. CCK-8 experiment and Cell scratch experiment showed that endothelial cells proliferation was obviously restrained at each time point in the Robo4 over-expression group ($p<0.05$), and the healing area of cells in the Robo4 over-expression group was reduced ($p<0.05$). In the experiment of Matrigel matrix gel tube experiment, the number of tubes in Robo4 over-expressed group was significantly reduced($p<0.05$). In conclusion, Robo4 was expressed in vascular endothelial cells, not in glioma cells, Robo4 can significantly inhibit the angiogenesis, proliferation and migration of glioma cells.

P1-N59

Modified acellular nerve-delivering PMSCs improve functional recovery in rats after complete spinal cord transection

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Due to the poor regeneration capacity of neurons and the inhibitory microenvironment, spontaneous regeneration in spinal cord injury (SCI) remains challenging. Tissue engineering is considered a promising approach for enhancing the regeneration of SCI by reconstructing the

inherent structure and improving the microenvironment. In this study, the possibility of engineering a nerve complex, which is constructed by acellular nerve delivering placenta mesenchymal stem cells (PMSCs), was assessed for the recovery of a transected spinal cord. Modified acellular nerve grafts were developed, and PMSCs labeled with green fluorescent protein (GFP) were seeded on the graft to construct the engineered nerve complex. Then, the engineered nerve complex was implanted into a 2 mm-length transected gap of the spinal cord. Four weeks after the transplantation, numerous surviving PMSCs were observed in the lesion cavity by immunofluorescence staining. Moreover, co-localization between GFP and neuro filament-200 (NF200) and Neuronal Class III β -Tubulin (Tuj1) was observed at the bridge interface. The PMSCs-graft group exhibited significant function improvement as evaluated by the Basso, Beattie and Bresnahan (BBB) locomotion score and footprint analysis. Eight weeks after surgery, the evoked response was restored in the PMSCs-graft group and numerous thick myelin sheathes were observed compared to that in the control groups. Collectively, our findings suggest that the nerve complex prepared by acellular nerve delivering PMSCs enhanced the structure and function regeneration of the spinal cord after SCI.

P1-N61

Human gray matter brain structure differences between therapy naïve gender dysphoric individuals and healthy controls

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Gender dysphoria presents a strong, persistent feeling of identification with another gender and also feeling of discomfort with individual's own assigned gender, causing at the same time significant distress inducing strong will to live in accordance with their gender identity by dressing and using mannerisms associated with the gender with which they do identify.
We performed a structural magnetic resonance imaging analysis in search of possible differences in gray matter structures in 10 therapy naive gender dysphoric individuals and compared those volumes with 15 healthy individuals. MR examination of both transexual and control subjects was performed using Siemens Avanto 3 T MRI device (Siemens, Erlangen, Germany) and eight-channel head coil. T2W images were used to exclude presence of gross brain pathology in subjects.
Examined structures were volumes of both left and right thalamus, caudate nucleus, putamen, globus pallidus, hippocampus, amygdala.The segmentation of subcortical gray matter was performed using the First, the model based segmentation/registration tool, from FSL software package. For statistical analysis, Kolmogorov Smirnov test was used to test normal distribution of examined parameters. All parameters had a normal distribution ($p>0.05$). To test average values of the parameters Student t-test and Levene's test for Equality of Variances were done. Binomial Logistic Regression was used to apostrophe important parameters for group prediction and at the start, the overall prediction was 57.5%, after four steps using Forward Conditional method, overall prediction shows 100%, for left thalamus HR=0.908, right caudate nucleus HR=1.070, right hippocampus HR=1.055.Analyses were done in SPSS 24 software package.
The results showed showed decreased volumes of the left thalamus, right hippocampus and right caudate nucleus, in indivuduals with gender dysphoria compaed to healthy individuals.
The study included an ethical statement that investigation was performed with the understanding and consent of the subjects.

P1-N63

Neuroplasticity and cytoarchitectonic organisation of verrucae hippocampi in the

entorhinal cortex of the human brain

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This study is approved from the ethic committee of the Central University Clinic of Medicine Prishtina, Kosovo, and from the ethic committee of Hospital Clinic of Tetovo, North Macedonia.
The aim of this work was the cytoarchitectonic analysis of the modular organisation of the entorhinal area of the human cortex. Investigations were carried out on postmortum material, on both parahypocampal gyruses obtained from the brains of 22 adult persons aged between 25 and 85 years who died without any signs of neurologic or neuropathogenic diseases.
Following fixation in 10% neutral formalin, lasting from 30 to 45 days, the parahypocampal gyruses were embedded in celloidin, cut in series along the tangential plan and stained according to the Nissl method. The sections were drawn using the lucid camera and Visopan produced by "Reichert". Graphic reconstruction of cytoarchitectonic units of the II layer was carried out on 12 brains. A total of 520 sections were analysed. The results show that the existence of cytoarchitectonic units in the form of bands and columns of stellar neurons are basic morphological properties of the cortex. It was established that regional differences exist in the distribution, shape and density of cytoarchitectonic units (columns and cell bands). Thus, in the rostral region of the periamygdaloid cortex to the most convoluted part of the uncus. In the middle levels, structural units are in the form of bands which shape bifurcations which end blindly. In the caudal section of the entorhinal area, there are irregular columns which gradually disappear. One of the most interesting findings of this work was the existence of statistically significant differences in the numerical density of stellar neurons and the area of columns between the right and left hemispheres.

P2-AA1

Human Macro & Micro Sectional Anatomy Art from Frozen Cuts to Cryomacrotome to Block-Face Microscopy: Chronological Evolution to 3D and Virtual Human Anatomy

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Human cross-section can be defined as non-empty intersection of a solid body in three-dimensional space with a planar slice, or the analog in higher-dimensional spaces. Sectional anatomy art is recognized in the sixteenth century from Leonardo da Vinci and Vesalius. Dilemma confronting anatomists/artists was a method which would maintain structural and spacial orientation of tissues during planar cuts. Objective of this study was to chronologically identify pivotal anatomists/artists and methods instrumental for today's Block-face scanning and human 3D/Virtual reconstructed imaging. Early 1800's, Dutch anatomist P. De Reimer published an atlas of sections from frozen bodies. In 1872, Braune published a popular comprehensive detailed sectional atlas employing a method by Rudinger which included bodies in high percentage alcohol. In 1873, Rudinger began publishing his work of frozen aided sections from adults and newborns in three planes, creating an infrastructure or template with data points for reconstructing anatomy into 3D imaging/art canvases by todays computer scientists, graphic designers, bioengineers and artists. In 1895, Dimitrie Gerota injected 5% solution of formalin prior to freezing and sectioning bodies. Terry, in 1900, made an important advance when he discovered a nonfreezing solution including decalcification with 10% hydrochloric acid. In 1901, Jackson reported a method via blood vessels. During 1950's, Dr. Whitlock created 1-

inch block slices from frozen-aided cadavers photographed manually. In 1989, Vic Spitzer using a cryomacrotome created 1mm cuts from frozen cadavers photographed digitally enabling accurate 3D reconstruction and bilaminar slices from macroanatomy datasets recognized today as serial block-face digital imaging. In 2004 Winfried Dank described serial block-face scanning electron microscopy using ultramicrotome enabling 3D reconstruction from microanatomy. In summary, sectional anatomy art was advanced significantly by German anatomists/artists, subsequently by British anatomists/artists and lastly by American anatomists/artists. Such art primed the pump for seamless interpretation of human cross-sectional (CT/MRI) imaging and 3D reconstructed anatomy.

P2-AA2

Frank Netter, an Empathetic Medical Illustrator who Humanized Anatomy Succeeding Henry Gray, Andreas Vesalius and Leonardo daVinci

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There are four anatomy physicians who influenced current anatomy teaching and learning during three periods of time: fifteen, eighteen and nineteen hundreds. In the mid 1500's, Leonardo da Vinci's anatomy illustrations revealed conceptual orientation, demonstrated architectural volume and precision of soft tissue, in particular the organs of unparalleled accuracy, like no other before him. Andreas Vesalius had a vision and directed Jan van Kalcar and others to illustrate his accurate detailed anti-Galenic anatomy into images mirroring his comprehensive and controversial text, especially of the musculoskeletal system - a work rivaling Shakespeare's sonnets. In the mid 1800's, Henry Gray, also a visionary, distilled extraneous text and sensory overloaded medical illustrations by guiding Henry Carter to create poignant illustrations while revolutionizing learning anatomy for clinicians. Collectively, da Vinci with his conceptual architectural stylus, Vesalius with his keen power of observation and detailed human dissections, Gray as the first contemporary networker with digestible text and illustrations are the influences used by Frank Netter in the mid 1900's. He humanized and personalized adult and paediatric anatomy with his gouache technique. Of the four notable author/illustrators only da Vinci and Netter physically created all their own illustrations. Vesalius and Gray defied current anatomy beliefs and/or teachings with accurate text and illuminating visuals supporting their visions. No doubt da Vinci's anatomy illustrations catered to mathematical, engineering and science aficionados. Netter's life experiences, training and passion enabled him to integrate the artistic and medical worlds. His kind demeanor with patients and their unfortunate conditions brought forth his empathy and sympathy resulting in humanizing anatomy.

P2-AA5

Anatomical art or artistic anatomy?

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As we age, interpretative art often gives way to that which is largely descriptive. However, this transition, with its emphasis on accuracy and detail, might favour rote learning rather than conceptual understanding. Here, I reflect on 10 works produced as an untrained recreational artist and consider the potential of interpretive art for anatomy learning and teaching.

Three subjects are presented: (i) a dissection of the anterior thigh (pencil/pastel on A3 paper -4 versions) (ii) a dissection of the femoral triangle (acrylic on A3 canvas -3 versions) and a coastal landscape (acrylic on A3 canvas -3 versions).

For all three subjects, the initial rendering was largely descriptive and characterised by measured

sketching and brushwork with the conservative use of shading and colour. Later versions were progressively more interpretive and characterised by fluid strokes and increasing use of large blocks of primary colour. Irrespective of subject, all interpretive versions were characterised by oblique lines and shapes for depth, emphasised by sweeping vertical strokes that cut across the main composition. The artist's experience was that the initial renderings were largely cognitive, pedestrian exercises, whereas subsequent versions were intuitive and much more enjoyable. Effective teaching generally addresses conceptual understanding before detail. In contrast, many who use art to facilitate anatomical understanding start with a cognitive approach that emphasises accuracy and detail. This study raises the possibility that an initial interpretive approach to art in anatomy may allow students to use abstraction to explore general concepts of shape and form before adding detail.

P2-AA8

An early method of anatomy for the artists by Tortebat in 1760, based on the plates of Vesalius

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The anatomical methods for the artists were rare in the 17th and 18th centuries. The aim of the study was to precise the anatomical accuracy of the plates of a french book by Tortebat, 1760, their scientific pertinency and usefulness for the artists. Material An in folio, complete sample of the "abstract of anatomy... for painters and sculptors" was studied in a late, 1760's edition, engraved by Tortebat and printed by de Crépy in Paris.
This book was read, pictured and its plates anatomically analised and measured.
There were successively: 1 pictured title, 4 pages of introduction; 1 page about "the bones of the human body" including a table of legends for the following 3 (full recto) pages of entire skeletons (as in Vesalius, 1543: left profile; postero-lateral right; anterior views). Then followed 7 (full verso) plates of muscular dissections on entire bodies with several depths and incidences; 2 superficial: anterior and left profile views; 2 anterior views with deeper and very deep dissections; 3 posterior views with superficial, deeper and to the bones (plus a brain cross-section and two cranial views) muscular dissections.
Their legends were detailed on 2 or 3 columns on the opposite (recto) page of the corresponding plates.
This book was late in the editions of the Tortebat's method which staged from 1667 to 1765 which progressively added new elements, mainly in the muscular legends with terminology and functional explanations becoming very modern. The almost similarity of the plates with the Vesalius' ones (1543) were interpretated by the differentiation of two different levels of depth on the same plate of the muscular dissections between the two sides. These early artistical methods were useful for the diffusion of the anatomical knowledge. Their scientific accuracy was excellent. There was no conflict of interest.

P2-AA9

How Do We Make Facial Expressions? A Study into how Plasticine Modelling can Aid the Public's Understanding of the Muscles of Facial Expression

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As the public's interest in human anatomy grows, more interactive and novel approaches to teach anatomy have been developed to aid the public's understanding of the human body. Arts-based learning is a fun and engaging teaching method that is being utilised within anatomy education, allowing for a relaxed environment for the public to actively learn about the human body. This research focuses on the use of plasticine modelling to recreate the muscles of facial expression on life-sized plastic skulls to aid the public's understanding of the underlying anatomy

that enables us to create facial expressions to communicate in our everyday lives. Research was carried out through a series of workshops open to non-anatomy and non-medical individuals, with plasticine modelling providing an accessible hands-on arts-based learning experience in anatomy education. Results of this research found modelling the muscles of facial expression in plasticine to be advantageous, facilitating an understanding of the anatomy of facial expression. This research gathered no personal data, therefore, no ethical approval was required.

P2-AA12

Male and female body as a model in anatomical iconography

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The male body has been associated with dynamics and strength. On the other hand, other attributes were associated with the female body - delicacy, softness and above all, the ability to reproduce. Reminiscences of these historical and cultural conditions have also influenced the anatomical iconography.
The aim of the presented work was to investigate the differences in the ways of using the male and female body as a model in anatomical figures.
The source materials were anatomical treasures and engravings from digitized resources of the U.S. National Library of Medicine, Universitätsbibliothek Heidelberg and Wellcome Library.
In sixteenth-century anatomical woodcuts, the female body appeared almost exclusively in relation to the female reproductive organs. The uterus was also the first organ that was illustrated independently - outside the pelvic cavity. The female body were displayed in the vicinity of decorative furniture, soft fabrics and draperies and symbols indicating fertility symbols (e.g. a vase as a symbol of the womb or feeding, a birthing chair). Vesalius was already aware that the general pattern of the structure of the human body, regardless of gender, remains the same. Naked bodies of a man and woman appeared for the first time in the treasure Epitome of Vesalius. Starting from the Renaissance; culturally influenced ideas about the structure of the human body were gradually replaced by a scientific canon. This trend was continued at the turn of the 18th and 19th centuries. In modern human atlases the male body is the basic model but there are deviations from this principle.
While analyzing anatomical illustrations it may be observed that the male body was depicted more frequently than the female body.
No ethical consent was required.

P2-DA1

Four learning tools of the Visible Korean contributing to virtual anatomy

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Thanks to the technological advancement in these days, virtual anatomy is having the limelight for its educational value. The virtual anatomy can be further improved with actual cadaver images processed in various methods. The aim of this study is to contribute to the virtual anatomy by providing learning tools made with the cadaver images of Visible Korean.
The sectioned images of a male's whole body were used for producing the four learning tools: the first tool to show the sectioned and segmented images; the second tool to show surface models of individual structures; the third tool to show a volume model that was continuously peeled from its surface; and the fourth tool to show a volume model that was freely sectioned by users.
All the tools can be downloaded from the Visible Korean homepage (anatomy.co.kr) free of charge. With the four learning tools, students may experience virtual dissection simulation regardless of the place, time, or economic status. The four tools had their own characteristics, so that they could be separately used for specific

achievements. Further, the combination of the tools based on the same raw data may result in a synergic effect.
Such free learning tools and commercial learning tools for virtual anatomy need to be improved to compensate and compete with each other. This study was intended to propose the possible learning effects of the four tools, which need to be verified by questionnaire survey of the medical students and co-medical students in the subsequent study.
The whole process for this study was approved by the institutional review board (AJIRB-MED-MDB-18-315).

P2-DA2

The Use of Virtual and Augmented Reality in Anatomy Teaching

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Developments in virtual reality (VR) and augmented reality (AR) mean educational use of the technology is becoming increasingly viable. Uptake of this technology in anatomy teaching is still limited. We examine the effectiveness of VR/AR in anatomy teaching including head mounted devices (HMDs), stereoscopic projectors and screens, AR Magic Mirrors and AR Magic Books.
PubMed, Scopus and Google Scholar were searched for relevant articles from 2013 to 29th June 2018.
Although confounding factors and heterogeneity between studies is likely to have a major impact on the results, there is general consensus that student satisfaction is significantly higher with all 4 VR/AR teaching methods than with traditional methods, (2D images, online textbooks and conventional tablets) for motivation, attention, confidence, autonomous learning and interest. There was considerable variation in the pre and post-test sampling used to assess academic performance with 4 studies using pre and post-testing, 4 only post and 1 only asking about satisfaction making comparative analysis testing.
Despite improvement between pre- and post-tests scores in one study on HMDs, the remainder showed no significant differences in post-test results compared with the control alternatives.
Students using 3D stereoscopic models (or 2D images) both significantly improved in results between pre- and post-tests ($p<0.001$), with 3D stereoscopy achieving significantly higher post-test results.
AR Magic Books performed significantly higher than those using a dissection video in a post-test sample with a significantly lower score distribution.
Drawing robust conclusions on the effectiveness of VR/AR from the literature is challenging. Confounding variables also include author and sampling bias, variation in the topic studied, the prior knowledge of students, sample size, timing and duration of testing and the absence of control groups.
Adverse side effects of VR/AR include dizziness, blurred vision and general discomfort to be balanced against the novelty of technology.
Ethical approval was not required.

P2-DA4

Virtual Microscopy using OMERO – Its relevance as a teaching tool in histology among first year medical students in India

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Histology forms an essential part of medical education. Unfortunately, it is encumbered by the need for a microscope making self-study outside the laboratory difficult. The lack of a good alternative for explorative learning hampers histology learning. Virtual microscopy (VM) is a recent advancement, which uses computers instead of microscopes and physical slides. In this study, we used an open source software called OMERO (a repository of high definition images of slides on a server) which allowed access to the images on any monitor, which was accessible by

the students. The aim of this study was to compare virtual microscopy based practical classes with conventional microscopy based practical classes for 1st year medical students, by comparing learning achieved using test scores and qualitative assessment of student's perspectives regarding the feasibility and usefulness of VM. The study was conducted after obtaining approval from the Institutional review board and written informed consent. Hundred students were divided into two batches of fifty each. Each batch underwent eight modules of which, four utilised conventional microscopes and four utilised virtual microscopes. Quantitative analysis was done using a post-test (which assessed preparation, theory knowledge and understanding) at the end of the session, in addition a spotter test (which assessed identification skills, reasoning and recall) was conducted one week after each session. Qualitative analysis was done by means of a structured questionnaire and focus group discussions. Results showed that modules using virtual microscopy were not inferior when compared to conventional microscopy , showing better and statistically significant post-test results($P < 0.001$), while differences in the spotter scores was insignificant($P = 0.28$) Qualitative analysis by means of questionnaire and focus group discussion corroborated with the scores, suggesting that the VM modules increased interest, enabled self-study and reduced student dependence on the tutor.

P2-DA5

A method for digitising plastinated anatomical specimens for interactive learning

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There is an increasing move towards using computer-generated 3D material for teaching anatomical content. This has been driven by the accessibility CG content provides; the ability to visualise internal or deep structures; the ability to interact with content; paired with the increased difficulty of obtaining cadavers. There are a variety of possible ways to create digital anatomical content. Here we describe a technique to use laser blue light technology to capture the 3D surface detail of plastinated specimens, which are then used to create interactive 3D content. Scanning & asset reconstruction was performed on two plastinated specimens of the horse distal limb available at the University of Murcia. One dissection was focused on the veins, arteries, and nerves, with another focused on the deep ligaments. Hardware used was an Artec Space Spider blue-light scanner and Artec Studio software running on a Windows 10 laptop with a dedicated GPU and 64GB of RAM. After reconstruction, further 3D softwares (Zbrush, Blender & the Unity game-engine) were then used to generate interactive content to allow the plastinated anatomical specimens to be used in a learning context. This content was provided free for veterinary students and academics at www.vin.com, and for all others via www.ivalalearn.com as a paid resource.

P2-DA7

Talairach-Tournoux atlases of the hippocampal formation based on the dataset of a high resolution digital human

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The advancement of modern clinical practice calls for a more precise morphological basis for the diagnosis and treatment of structural hippocampal lesions. The purpose of this study is to generate high-definition three-dimensional

digital Talairach-Tournoux atlases of the human hippocampal formation (HF) using high-resolution images produced from thin serial sections of digital human.

An adult Chinese female cadaver, which was visually examined, CT and MR scanned to exclude the possibility of craniocerebral lesions, was selected. The entire cadaver was fixed in 10% formalin, embedded with gelatin in anatomical position, frozen at -30°C and serially cross-sectioned with digital milling machine at 0.1-mm intervals. High-resolution images (12000 × 8816 in pixels) of each section were collected by a digital line scan camera and imported to the imaging workstation. A sequence of 1051 cross-sectional images containing the HF and adjacent structures (basal nuclei, corpus callosum, lateral ventricle, etc.) was selected and processed. Finally, 2 Talairach-Tournoux atlases of adult Chinese female HF was created by means of volume reconstruction and surface reconstruction respectively. The protocol of this study was approved by the Medical Ethics Committee of Shandong University.

The serial sectional images used for three-dimensional reconstruction are of exceptional quality; the display of the atlases is clear and realistic. The atlases provide sagittal, verticofrontal and horizontal view in the Talairach-Tournoux reference system, but also enable the exploration of sectional anatomy of HF and adjacent anatomical structures from any other direction. These atlases will aid medical students and clinicians to acquire a better knowledge of the anatomical structure of HF and its spatial relationship to other anatomical structures. They will also be helpful in understanding and designing neurosurgeries of related cerebral regions.

P2-DA8

Cyber anatomy: An innovative tool for learning anatomy for undergraduate students

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Anatomy teaching methods have long been a topic of debate. Currently, advanced teaching methodologies are being adopted either in addition to, or instead of the cadaver-based methods. Purpose of this study was to make learning of anatomy easier for the students, by adopting a 3D visual and interactive software, validated by anatomy professors as compared to other technology enhanced learning approaches.

In a comparative cross-sectional retrospective study, 400 students (1st year MBBS, taught thorax for 10 weeks, and 2nd year MBBS, taught abdomen and pelvis for 12 weeks) were divided into groups A and B, and were observed in two consecutive years. Both groups included 200 students, 100 in each subgroup. In both the sessions, each class was divided into 4 batches (25 students in each). Every batch attended a 40 minutes demonstration (4 days/week). Group A (subgroup A1- 1st year MBBS and subgroup A2- 2nd year MBBS) was taught using only conventional methods. Demonstration was followed by any one of the following: dissection/ prosection/ models/ assignments. Teaching to Group B (subgroup B1- 1st year MBBS and subgroup B2- 2nd year MBBS) was technology based in addition to conventional method. Demonstration was followed by dissection/ prosection/ models/ assignments + VIVED Cyber Anatomy (Learning spatial relationship using functions like rotating, panning, peeling and hiding the anatomical structures within the software). The performance of both groups was assessed during the final stage examination of the respective regions. Results showed that there was improvement in the performance of the students, however, the results were statistically insignificant.

Combination of teaching methodologies could be an effective way of teaching anatomy. However, short duration of study and specific regions of human body chosen were factors that can be

overcome to get a better prediction about students' performance.
The study was approved by institutional Ethical review committee.

P2-DA9

Visualization and Measurement of the Caudate Nucleus of the Brain from Computed Tomography Angiography

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The caudate nucleus, having a unique shape and features, is an extremely important structure within the brain. It is associated with the putamen, thalamus, and lateral ventricle. Curved and shaped like a "C," the caudate nucleus has a head, body, and tail. The three-dimensional (3D) relationships among these structures are quite complex and often difficult for students to understand. The caudate nucleus plays an important role in learning, memory, emotion, and integration of spatial information with various body movements. Therefore, patients with caudate atrophy, damage, or dysfunction will present with memory deficits, affective disturbances, personality changes, and other manifestations of motor dysfunction such as Parkinson and Huntington diseases. The caudate atrophy can often be detected on brain imaging with a computed tomography (CT) or magnetic resonance imaging (MRI) scan. In this study, the stereoscopic caudate nucleus model was developed from 505 axial slices of a single deidentified computed tomography angiography (CTA) scan provided by the University of Mississippi Medical Center (UMMC) Department of Radiology with a Siemens SOMATOM Definition CT scanner. The model was constructed using Amira software, version 5.6, relying on manual segmentation techniques. The bone of the overlying skull was constructed using a volume rendering technique. This study was approved by the Institutional Review Board of UMMC. Two-dimensional (2D) and 3D measurements can be applied to measure the length, angle, and volume of the caudate nucleus. The virtual model of the caudate nucleus can be displayed in a stereoscopic view to allow students to rotate, zoom in, and zoom out of the model. The 2D and 3D measurements of the caudate nucleus provide a quantitative comparison of the structure, potentially helping students, residents, and clinicians understand the spatial orientation of the caudate nucleus in the human brain and elucidate the development of some of the structure's common pathologies

P2-DA10

Visible Korean: Advanced sectioned images with real color of human head

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In 2009, real color sectioned images of a cadaver head were produced in the Visible Korean. The images became essential materials for learning sectional neuroanatomy. On the other hand, the image resolution is insufficient to observe detailed structures suitable for experts. The purpose of this study is to present real color sectioned images of female head with higher resolution than previous studies.
This study received the ethical approval in Ajou university IRB (AJIRB-MED-MDB-18-315). After 3T MRI and diffusion tensor images of the female cadaver head were acquired, the head was frozen and sectioned using a cryomacrotome. Using digital camera (resolution, 8,688 x 5,792), the sectioned surfaces were photographed to make sectioned images.
On the resulting 4,000 images (intervals and pixel size, 0.04 mm^3; color depth, 48 bits color; a file size, 288 Mbytes), minute structures were

observed not on previous sectioned images but on neuroanatomic stained slides as follows. Ammon`s horn of hippocampus proper, external and internal magnocellular layers of lateral geniculate nucleus, and cerebellar nuclei were identified, similar to neuroanatomic stained slides. Each nucleus of thalamus with pallidothalamic tract were identified. Detail structures in brainstem and spinal cord were identical, similar to neuroanatomic stained view too. Furthermore, the sectioned images were combined with tractography of the diffusion tensor images to elucidate the white matter with high resolution and the actual color of the tissue.
The voxel sizes of this study (0.04 mm^3) was very minute compared to our previous study (0.1 mm^3; resolution, 4,368 x 2,912) and and Visible Human Project of the USA (0.33 mm^3; resolution, 2,048 X 2,048). Sectioned images of this study will serve as the foundation material in the field of sectional anatomy. The images of this study will provided to other researchers for making virtual reality using 3D models.

P2-DA11

A 3D reconstruction of the Human Vermis of the Cerebellum for Dejerines' Atlas

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The first volume of « Anatomie des Centres Nerveux » from J.Dejerine (1849-1917) and A.Dejerine-Klumpke (1859-1927) was published in 1895 and the second volume in 1901. Dejerines' atlas has subsequently remained a human standard reference for teaching, clinical work and neurological research. A 3D brain atlas based on Dejerines' description has been available since 2018 at dejerineatlas.com. Our aim now is to provide a 3D model of the human vermis of the cerebellum by following the same methodology used for describing the cortical gyri within the Dejerine atlas. Using 400µm reconstructions (from file full16_400um.nii) of the Big Brain (Amunts et al., 2013; https://bigbrain.loris.ca), we performed manually segmentation of the cerebellar grey matter. Dejerines' descriptions were followed and MRIcron software (http:/www.mricro.com) was employed to construct 2D images. The 3D reconstruction of the drawings was enabled using Mango software (http://ric.uthscsa.edu/mango/mango.html). The final results were added to the Dejerine Big Brain Atlas on the Vizua platform (dejerineatlas.com). No ethical approval was required. The pons, the vermis of the cerebellum and the deep cerebellar nuclei were segmented manually. The terminology used by Jules Dejerine and Augusta Dejerine-Klumpke was adapted in accordance with the FIPAT Terminologia Anatomica (see http://www.unifr.ch/ifaa) as numerous terminologies have been employed to describe the cerebellar structures by previous researchers. With the exception of the dentate nuclei, the Big Brain file (full16_400um.nii) used in the present investigation did not allow segmentation of the deep cerebellar nuclei from the cerebellar white matter. The segmentation of the structures of the human vermis of the cerebellum were successfully reconstructed, allowing the identification of the main morphological and functional divisions of the vermis. This reconstruction will become part of Dejerines' Big Brain Atlas, providing a significant teaching and educational resource.

P2-DA12

Real color volume models based on the true color sectioned images of Visible Korean

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Volume models enable the observation of body structures on not only horizontal, coronal, and sagittal planes but also various oblique planes. Therefore, a volume model can be useful in educating the concepts of sectional and clinical anatomy. Real color volume models from true color sectioned images (> 24 bit color) are naturally superior to grayscale volume models (< 8 bits gray) from MRIs, because the sectioned images are superior to MRIs. However, real color volume models are mostly commercial and their production methods have not yet been released. Thus the aim of this study was to release a real color volume model with a segmented volume model and its production methods.

This study received ethical approval at the Ajou University of Korea (No. AJIRB-MED-MDB-18-315). The original voxel size of head sectioned images with true color was increased from 0.1 mm to 0.5 mm and converted to DICOM format using Photoshop. Using a script tool in the Dicom Browser, instance numbers in the header of each DICOM file was changed to serial time automatically. Using MRIcroGL, the DICOM files were reconstructed by volume modeling to produce a real color volume model. Through the same process, a segmented volume model was produced based on the segmented images of 297 head structures.

In real color volume model of the human head, various sectional planes of true color and real shape in the body was shown vividly. In segmented volume model, accurate boundaries of real shapes in the body could be seen.

Volume models can be used by medical students and doctors to learn sectional anatomy. Other researchers can also utilize this method to produce volume models from their own sectioned images.

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P2-DA13

Three-dimensional morphology and asymmetry of the intraparietal sulcus in Chinese brain

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The pattern and morphological features of the intraparietal sulcus(IPS) were explored on MRI in vivo using 3D visualization methods, so as to provide anatomical basis for the brain function studies of the parietal lobe as well as the diagnosis and treatment of the related diseases. 107 right-handed Chinese subjects were selected and scanned to acquire high quality MR images of the brains using 3.0T high-resolution MRI scanner, and all subjects signed the informed consent for the study, which was approved by the ethics committee of Shandong University School of Medicine. The 3D anatomical model of the IPS was reconstructed by BrainVISA(http://www.brainvisa.info), then the morphological patterns and parameters of the IPS were observed and analyzed. There are three types of the IPS: continuous type(44.60%), two segments type(50.23%) and three segments type(5.17%). The position relationship between the IPS and the adjacent cerebral sulcus (post central sulcus and transverse-occipital sulcus) can be divided into four types: none-connection type, true connective type, pseudo connective type and transfixion type. The IPS mainly has three branches: the sulcus of Brissaud, anterior intermediate parietal sulcus of Jensen and posterior intermediate parietal sulcus. After the spatial normalization, the top length(TL), bottom length(BL), average depth(AD) of the left hemisphere IPS in males are larger than the right hemisphere ($P<0.05$); the TL and BL of the left hemisphere IPS in the females are larger than right hemisphere ($P<0.05$). Our findings indicated that the morphology of the IPS is very complicated and this study will be helpful for clinical imaging researches on development, intelligence and neuropsychiatric disorders in the parietal regions.

P2-E1

An analysis of medical students' attitude and motivation in pursuing an intercalated MSc in Clinical Anatomy

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This study aimed to explore what factors influence and motivate medical students to undergo an intercalated degree, and why they prefer to choose an intercalated MSc in Clinical Anatomy. The study consisted of 54 medical students enrolled in Queen's University, Belfast which offers a range of intercalated degrees including an iBSc in Medical Science and an iMSc in Clinical Anatomy. Ethical approval was provided from Queen's University, Belfast. Five-point Likert-scale survey was used to collect data, designed to discover what the influencing factors were in deciding to take an intercalating degree and if they have a desire to gain research experience. It measured the motivational features of their chosen courses. The findings have demonstrated that in recent years, more students (68.5%, n=54) opted for the iMSc in Clinical Anatomy rather than the iBSc in Medical Sciences. This difference in number of students was statistically significant (Chi-square=33.4, P<0.0001). It was theorized that this was due to an interest in future surgical specialization, however this study has shown that the prime reason 72.2% of students opt to take a year out of their medical degree to carry out an intercalated degree is simply to gain an extra-qualification while 61.1% thought it would enhance their competitiveness in job market. Ninety four percent of iMSc students recommended the intercalated degree to junior students in comparison to only 34.8% iBSc students. This difference in percentage was statistically significant (t=2.78, P=0.009). The study shows no significant link to a desire to gain research experience in determining which intercalated program to undertake. Students favoured iMSc more because they believed it will enhance their employability and prepare them to be a clinician with a better knowledge about clinical anatomy.

P2-E2

Perceptions and Opinions of Postgraduate Residents and Students of Anatomy Regarding Construction of Neuroanatomy Short Answer Questions (SAQs)

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The written exams of the undergraduate medical (MBBS) Anatomy courses in Bangladesh mostly use Short Answer Questions (SAQs). However, constructing good SAQs is not an easy job. Low reliability in constructing and subjectivity in marking answer scripts are almost inherent in traditional SAQs. But no specified guidelines are currently available for the question-setters or moderators of SAQs in Anatomy. Formulating such guidelines calls for organized needs analyses of various stakeholders of SAQ. The research aimed to analyze the perceptions and opinions of the Bangladeshi postgraduate residents and students of Anatomy regarding different aspects of SAQs, including attributes of a good SAQ. The research was done in the Department of Anatomy, Bangabandhu Sheikh Mujib Medical University (BSMMU) after receiving the ethical approval from the Institutional Review Board (IRB) of BSMMU. A self-administered questionnaire-based survey via e-mail was planned among all the Bangladeshi MS residents and MPhil students of Anatomy who had passed the Neuroanatomy portion of their course, and who would agree to participate in the survey after getting informed consent. Thirty eight (88.5% of the eligibles) residents/students responded. Perceptions and opinions were sought regarding definition and characteristics of SAQ, direction words, allotment of marks, expected answers to different types of SAQ, marking of answers to SAQs, problems faced by

residents/students about SAQ, needs for improvement of their existing quality, importance and necessity of SAQ guidelines and issues to be prioritized in the guidelines. The results contributed to developing an insight into the existing weaknesses and strengths of construction of SAQs and identified the specific needs for the proposed SAQ guidelines in the eyes of an important stakeholder. A useful set of SAQ guidelines can be formulated utilizing the results along with the teachers' perceptions and opinions already collected and the data of further needs analyses on other subdivisions of Anatomy.

P2-E3

Medical Anatomy at the University of Bristol: A journey through curriculum change

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There is widespread recognition that a sound understanding of anatomy is critical for doctors to effectively examine and perform clinical procedures on their patients. The discipline of anatomy has always had a key position in undergraduate medical curriculum, but due to persistent decline in anatomy teaching hours since the 1960s through curriculum change, there has been significant change in how anatomy is delivered.
At the University of Bristol's Centre for Applied Anatomy, innovation is encouraged, and curriculum change is seen as a continual process of refreshing material and striving for excellence. Between 2015-2017 a significant review of the entire medical programme was undertaken: 'MB21'. Key challenges have been to restructure medical anatomy teaching to sit not just in the early years, but as part of a helical theme threaded through the entire programme. We have also considered content detail working alongside biomedical colleagues to ensure full interdigitation of teaching and aligning this to gold standard guidance such as the GMC Outcomes for Graduates and the Anatomical Societies core syllabus for anatomy.
Observations in the first two years has been better integration between anatomy and the biomedical sciences and increasing spiralised learning of anatomy applied to clinical practice. Student satisfaction with the anatomy teaching has remained high as evidenced from internal survey data. Moving forward, anatomy will have a stronger more visible position in the higher years of the programme with new practical sessions currently under development.
Medical curriculum change is not new, but by working together and embracing change, we hope that across the next 3y we will see graduates of MB21 leaving with some of the best integrated anatomical knowledge to take forward with them into clinical practice.
No ethical approval required.

P2-E4

Inconsistencies of current anatomical terminology: adjusting suggestions

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The anatomical terminology is an important tool to equalise communication, enabling a clear and understandable language. The last revision of latin nomenclature was made by the Federative Committee of Anatomical Terminology (FCAT) in 1997 in Rio de Janeiro. Such work aimed to identify the main inconsistencies within anatomical terminology and to suggest more appropriate terms for them. Through a judicious revision of the official anatomical terminology, the main inconsistencies were identified and more appropriate terms were suggested according to the criteria pre-established by the FCAT. After analyzing the anatomical terms 12 inconsistencies were identified. As it was a theorietical study, the ethical approval was not

required. In order to get greater clarity and understanding of the anatomical study of certain regions we suggest the following adjustments for such inconsistencies: Grater e lesser sciatic notch for "Iliac notch" and "sciatic notch" respectively. Basilar sulcus for “groove for basilar artery” or “median pontine sulcus”. Posterior intermediate sulcus for “Posterior-medial sulcus” of the medulla oblongata and spinal cord. Jugular notch for “suprasternal notch”. Vena caval foramen for “vena caval ostium”. Glenoid Cavity for "Glenoid Fossa", erector spinae muscle for “ erector of the column muscle”. Iliocostalis cervicis muscle for “costocervicalis muscle”. Omohyoid muscle for “scapulohyoid muscle”. Superior and inferior ulnar collateral arteries for "proximal and distal ulnar collateral arteries". Tuberosity of the 5th metatarsal bone for “styloid process of 5th metatarsal”. Among the principles that guide anatomical terminology, factors such as location, direction, form and/or function should be taken into account in a descriptive and informative form, in the simplest possible manner, thus facilitating the student's understanding of anatomy. The application of the adjustments to the identified inconsistencies follow perfectly the criteria of the anatomical terminology, facilitating the understanding and study of such structures.

P2-E5

Exploring whether Traditional Lecture or Problem Based Learning approaches improve knowledge gain and student perceptions within neuroanatomy near-peer teaching

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Time dedicated to anatomical teaching in the UK has been declining, resulting in institutions focussing on alternative teaching approaches, such as Near Peer Teaching (NPT). While NPT benefits are widely established, there’s little research on optimising this approach. Problem Based Learning (PBL) boasts increased student satisfaction, whilst Traditional lecture style (TLS) benefits teaching of complex scientific content. While both approaches are well researched, their efficacy within NPT is not. This study aims to compare TLS and PBL methods of teaching head, neck and neuroanatomy in NPT.

In week 2 of an 8-week module, 3rd year students (n=16) at Southampton Medical School taught all 2nd year students (n=215). 6 cranial nerves were taught via TLS and 6 via PBL in students’ first exposure to this topic. Participants were blinded and experienced both teaching styles, providing matched samples. The students completed a pre-teaching test, post-teaching test and perception survey. 12 of these students later took part in 2 focus groups, which were transcribed and analysed using thematic analysis.

Thematic analysis identified 4 themes; Perceptions of Neuroanatomy, Benefits of NPT, Approach of NPTs and Attitudes to Teaching Approaches. Investigating the last theme showed students valued NPT in both PBL and TLS. The perception survey yielded no significant differences between approaches across all questionnaire criteria. While students demonstrated significant knowledge gain with both approaches ($p<0.0001$), analysis showed no significant difference in mean normalised knowledge gain.

This cohort study demonstrates no significant differences in the student experience or in academic achievement when using PBL and TLS approaches within a NPT programme. Students feel NPTs are able to use both approaches, and prefer TLS to be implemented first, to introduce information, followed by reinforcement using PBL, suggesting both options are viable strategies in NPT delivery.

This study was approved by the Faculty of Medicine Ethics Committee.

P2-E6

Modernising Histology Teaching in Medical Education: A Study to Support Blended and Integrated Approaches

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Student feedback at the University of Southampton revealed that medical students regard histology as uninteresting and lacking in relevance for their future careers, and that traditional teaching methods are not sufficiently engaging. This motivated the redevelopment in teaching style to a new format (NF) that integrates histology with gross anatomy, alongside providing online resources such as ePracticals and team-based histology workshops. This study aims to evaluate the effect of this NF on student assessment results and student perceptions of histology.

Histology-specific assessment scores of multiple cohorts who experienced the old format (OF) were compared to that of cohorts who experienced the NF, using the Mann-Whitney U test. Data from questionnaires offered to a recent cohort who experienced the NF was compared to that from questionnaires completed by OF students at the time of study. Module evaluations and focus groups provided further data to assess student perceptions. This study was approved by the University of Southampton ethics committee (submission ID 30327).

Assessment data revealed that Year 1 NF scores were significantly higher than the OF (median score 62% vs 55%, $p<0.001$). Comparison of Year 2 data was inconclusive. Questionnaire data revealed that although its relevance was rated higher with the NF (median Likert score 6 vs 4, $p<0.05$), student opinions regarding other parameters of histology teaching have not significantly improved. By contrast, module evaluation data shows that students on the NF rated histology better than those on the OF. Thematic analysis of focus group data identified key areas for further improvement, including increasing online resources and feedback.

In conclusion, the NF has yielded some improvement in student assessment scores and appreciation of the relevance of histology. Refinement in key areas is required to fully harness the potential of this novel approach to histology teaching.

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P2-E7

Developing an integrative pathology resource with potted specimens and case-based learning; curation and evolution of a human anatomical study space

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Pathology as a subject is becoming increasingly side-lined in the crowded modern professional curriculum. But its relevance to these courses should not be underestimated. This lack of attention has potential implications for the graduate, including lack of basic pathological knowledge, and lack of insight into histopathology as a clinical specialism or postgraduate destination. If properly utilised, its application to the study of anatomy will also serve to augment anatomical teaching to students on both our professional and science courses.

Our collection of pathological potted specimens at the Centre for Applied Anatomy has provided a basis to integrate microscopic and macroscopic pathology into independent study time and can serve as a valuable extension of dissection room time, limited by other subject commitments and the need for student supervision. This has led to development of a study space for specimen display and practical use.

Pathology pots were examined and summarised for their macroscopic contents, to highlight their key features, and then assigned; 1) microscopic figures attributable to the pathology, 2) a case history, consisting of typical findings on patient assessment and a series of differential diagnoses, together with a suitable investigation and management plan and 3) a series of questions pertaining to relevant anatomical concepts to challenge student knowledge.
Pathologies were also extensively curated and grouped into categories according to shared symptomatology and differential diagnoses, along with embryological resources and curiosities, based on the historical context of pathology.
This method of display, curation and integration of these valuable resources hopes to bridge the gaps recognised in the modern curriculum with regards to both pathology and anatomy, paving the way for increased access to cadaveric tissue teaching tools, whilst supporting the study time of our students on both professional and science-based courses.
Appropriate ethical considerations made – no approval required.

P2-E8

"SnapAnatomy": the development of a game to engage audiences in Anatomy

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The use of games as an effective method of teaching anatomy has increased in various healthcare science subjects in recent years. It has been shown that teaching through playing games promotes student engagement and encourages teamwork among players which enhances student learning. The newly developed "SnapAnatomy" game aims to increase knowledge and understanding of anatomical terminology (combining with function) through a modified version of the traditional game 'Snap'. We have developed the game so that the target audience can learn anatomical concepts through a fun, enjoyable and interactive activity which is accessible to a variety of audiences. The game contains maximum of 55 A4 cards and takes approximately 10 minutes to complete depending on the group size. The game is based on a principle of player interaction according to which cards have an image of an anatomical structure in common. Players are supplied with a minimum of 4-5 cards at the beginning of the game. The first player to correctly identify a matching anatomical structure on the card calls it out loud and matches the two cards identical cards before their opponents. The game is played by correctly 'snapping' identical anatomical structures on each card. The end of the session, participants were invited to give feedback on the activity by writing down three words that they felt described their experience. The outcomes of the participant feedback (n= 25) are reported as a word-cloud. Our results show that participants mainly reported that the SnapAnatomy game was "interesting", "fun", "good" and "creative". Therefore, we have evidence that the game may provide a starting point for teaching Anatomy to varied audiences in an engaging, stimulating and fun way. Furthermore, the game that we have developed is low cost and easy to modify for use with a variety of audiences.

P2-E9

Innovative Handheld Ultrasound-Probe-System Utilizes Artificial Intelligence for Teaching Face-to-Face Sonoanatomy with Human Cadaver for Lab and Distance Learning via Cloud

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Natural disaster triage, increased emergency medicine visits and military field medicine outcomes have increasing time sensitive expectations which could be addressed integrating artificial intelligence(AI) with ultrasound. Issues and solutions are ultrasound design, medical education, anatomy, teaching-learning theories, internet byway and emerging technologies. Notable shortage of ultrasound educators for face time teaching requires cross-pollination from peripheral experts to deliver ultrasound skills worldwide. Objective of study was to identify a handheld wireless battery-powered-ultrasound-probe-system using AI acquiring quality imaging(QI) enabling andragogy and heutagogy teaching techniques of sonoanatomy for distance learning to healthcare providers globally. Technology insider knowledge revealed Clarius handheld wireless multi-probe ultrasound-probe-system compatible with Apple and Android mobile devices. QI was acquired on cadavers and comparable to cart-based systems, allowing universal sonoanatomy teaching and learning. Clarius is shock and water resistant and utilizes automated AI with real time automated time-gain-compensation(TGC) engine. Traditional ultrasound systems require users adjusting several TGC controls to optimize imaging and when changing scanning planes, differences in tissue results in attenuation variance and forces users to adjust TGC. Clarius automated AI overrides user interaction with TGC controls if desired. Analyzing each single ultrasound image captured during scanning at rates of 30 frames per second, gain can be tuned with high level precision to 1mm, all in real-time, with instant feedback. Clarius App is a secure point-to-point wireless network enabling both user and learner(s) to view images on mobile devices simultaneously within a room or via cloud from continent-to-continent. In summary, Clarius(handheld-wireless-battery-powered-ultrasound-probe-system) reaches remote/dense regions within and between countries with possibly limited resources (imaging, electrical, lack of and/or minimally trained providers). Clarius technology uses AI to provide easy high resolution imaging for universal sonoanatomy teaching/learning and fertile distant learning development incorporating machine and/or deep learning techniques providing classic competency and innovative capacity learning. IRB approval granted for cadaver research.

P2-E10

Student-Authored Autopsy Reports of Anatomical Donors, Their First Patients

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Vertical integration of the basic and clinical sciences was achieved during the past two years by including both radiology and pathology in the gross anatomy course, culminating in a student-authored autopsy report. Anatomical donors were scanned using computerized tomography (CT) and student groups were provided with a dataset of their donor and a report written by a radiology resident. As students dissected, they took photographs and biopsies of any pathological findings that were then processed for microscopic evaluation. Each group wrote an autopsy report using relevant images of the CT scan, macroscopic and microscopic findings, and postulated the cause of death in consultation with clinicians from both radiology and pathology. Pathologies found included stroke, lung carcinoma, amyloidosis, emphysema, adenocarcinoma and myocardial infarction, among others. Autopsy reports were evaluated by the radiology and pathology faculty, and each student group received written feedback with respect to content, accuracy, completeness and whether faculty agreed with the proposed cause of death. An anonymous survey was distributed and the majority of those answering the survey agreed that this exercise was valuable or somewhat valuable. The majority of students answering the survey agreed or strongly agreed that they were able to interpret the CT scan

themselves, that the exercise should be repeated next year, that they gained insight into the clinical manifestations of disease, that meeting with a pathologist was interesting and that the time required to prepare the report was adequate. The majority of respondents somewhat disagreed, strongly disagreed or were neutral as to whether preparation of the autopsy report resulted in their being more engaged during the Anatomy course. Student-authored autopsy reports of anatomical donors could be adopted at other medical schools if departments are willing to provide faculty and financial support.
This project was exempted by Columbia's Institutional Review Board (AAAS2219).

P2-E11

Supervised human anatomy laboratory time and its effect on short- and long-term academic course grade performance

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Reduced human anatomy curricula have resulted in limited supervised laboratory time. However, it is not known how much supervised laboratory time is needed in a graduate semester-long human anatomy course to impact short- and long-term academic performance. The authors investigated the relation of time spent in supervised human anatomy laboratory experiences and academic success in a graduate allied health program. It was hypothesized academic performance would be negatively impacted with less than 45 hours of supervised laboratory time. Graduate occupational therapy (OT) students' academic performances were analyzed retrospectively. Group A students (n=83) had 90 hours of supervised laboratory time, dissected human cadavers, and received traditional face-to-face learning. Group B students (n=58) had 45 supervised laboratory hours with prosected cadavers only, and received a hybrid format (online/face-to-face). Group C students (n=55) had 16 supervised laboratory hours with prosections, and predominantly online instruction. The following academic performance measures were investigated between groups with data spanning over four years: human anatomy course grades (final course/written exams/laboratory), kinesiology final course grade, neuroscience final course grade, and orthopedics final course grade. Group B had higher short-term anatomy grades (final grade and written exams) than Groups A and C ($p<0.05$). No differences in anatomy laboratory grades were seen between groups ($p>0.05$). Long-term academic performance was similar between Groups A and B ($p>0.05$). However, Group C had lower grades in kinesiology compared to Groups A and B ($p<0.05$), and lower grades in orthopedics as compared to Group A ($p<0.05$). This study indicates reduced supervised laboratory time (from 90 to 45 hours) does not negatively affect academic performance. However, academic performance may be lower when supervised laboratory times are reduced to 16 hours. Graduate programs should consider providing a minimum of 45 supervised laboratory hours for human anatomy courses. Concordia University-Wisconsin (USA) Institutional Review Board approved this study.

P2-E13

An investigation into the causes of gender disparity in STEM academia and the associated impacts upon education

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The topic of gender disparity in academic positions within STEM (Science, Technology, Engineering and Mathematics) in higher education is under current public debate. However, the impact of such gender imbalance upon teaching practice and student engagement is seldom acknowledged. The aim of this research was to uncover the effects of the paucity of females in high tenure roles upon students in the Faculty of Science (FoS) at the University of Sheffield (UoS). It is hoped that the results of this research shall aid policy makers within the

Department of Anatomy and university-wide to implement changes in pedagogical methods.
Individual semi-structured interviews were conducted with equality, diversity and inclusion (EDI) leads for 5 departments (Chemistry, Mathematics, Physics, Molecular Biology and Animal and Plant Sciences) within the FoS at UoS. The interviews were then transcribed and coded. Ethical approval was obtained from the University Ethics Committee at Sheffield.
4 causes of staff gender imbalance were identified in 100% (n=5) of the departments interviewed: 1) Raising a family 2) Lack of female role models 3) Recruitment processes 4) Cultural pressures. 60% (n=3) of departments were driving initiatives to improve gender equality; 80% (n=4) of EDI leads stated a lack of female staff negatively impacts female students in terms of career progression and 40% (n=2) of departments had made changes to their curriculums to improve gender equality.
From this research, and associated literature review, it can be concluded that the gender and associated behaviours of a teacher can not only affect the retainment of students in HE, but also their confidence in ability and overall well-being whilst studying at university. Although limited by number of participants, this research provides an important insight into individual departments at the UoS which can be used university and nationwide to improve the delivery and overall quality of education.

P2-E14

Thiel Embalmed Cadavers Use for Training in NOTES Neck Surgery: Is this a Suitable Platform?

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Surgical training has faced increasing challenges throughout the globe. Restrictions on working times and fast development of new surgical procedures have warranted alternative training setups. Natural orifice transluminal endoscopic surgery (NOTES) of the neck is a particularly good example of this. The unique preservation advantages of Thiel embalmed cadavers have been deemed a feasible alternative platform for training in a number of surgical techniques. This study assessed the use of Thiel embalmed cadavers in Transoral endoscopic thyroidectomy via vestibular approach (TOETVA).
Three Thiel embalmed cadavers were used for this study. A general surgeon who was a novice to the technique carried out the procedures in all cases using standard equipment and following the published operative technique. Anatomical measurements and time taken to perform the procedure were recorded. Tissue and operating space characteristics were rated by the surgeon. The recurrent laryngeal nerve, trachea, oesophagus, internal jugular vein and carotid artery were assessed after the procedure to evaluate whether there were any unforeseen injuries.
In the cohort of cadavers used, the tissues in the mouth and neck maintained realistic elasticity, texture and colour for the procedure to be carried out. Carbon dioxide insufflation (6mmHg) was enough to maintain a good working space with clear visibility and the gingival tissues were able to maintain a good seal around ports. Tissues in the cadavers dissected maintained high-quality life-like elasticity. The recurrent laryngeal nerve was not well characterized in two of the three cadavers. Retrieval of the thyroid gland through the vestibule after dissection did not pose any difficulty. No damage to surrounding structures was identified on open assessment for all three cases. The parathyroid glands could not be identified.
The Thiel embalmed cadavers used offered a suitable life-like alternative platform for training in this innovative technique for the novice surgeon.

P2-E15

Virtual dissection: developing a pedagogy that works in undergraduate medicine

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Anatomage is an innovative system enabling the use of virtual dissection within the classroom, forming part of a new era of digitally enhanced anatomy learning. Following integration of this system into the curriculum the Anatomy department at Peninsula Medical School conducted a qualitative study to understand students' perceptions of the Anatomage system and the barriers and enablers that affect their level of engagement with it. With the aim to identify curriculum improvements to respond to issues raised.

This study utilised focus groups of first and second year undergraduate medical students to gather detailed narratives for analysis. Thematic analysis then identified themes from these narratives. This research received ethical approval from the University of Plymouth and the consent and understanding of all participants.

Students clearly appreciated how the system could enhance their learning. However, while society assumes the millennial generation is adept at using technology, the most frequently raised challenge was learning to use the system.

"I think it definitely is amazing, but quite honestly I feel so quite wary of it cos I don't know how to use it"

Another area of difficulty was the range of ability within dissection groups.

"so you have one person ploughing through it and then someone who's sitting behind like I have no idea what's going on"

These challenges were addressed by improving our induction process, approach to group dissection and format of the dissection guides, to ensure all students profit from this system. This research has led to an improved integration of new technologies into the curriculum at Peninsula . It also includes more generalisable messages applicable to all dissection tasks such as group sizes, equal opportunities and time allocation.

P2-E16

Development of Task Orientated Practicals (TOPs) to encourage active learning in anatomy

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The Task-Oriented Practical (TOP) is a learning session which comprises a series of tasks that are accomplished by groups of students at stations. A station is an area equipped with relevant learning resources designed to enable students to complete the task and achieve the specified learning outcomes. 139 first-year medical students took part in combined gross anatomy, histology and embryology TOP of the urinary system. In order to measure the effectiveness of the stations' design, post-learning tests were performed to assess students' short-term retention of information. Student satisfaction surveys were also conducted before and after TOPs were introduced. A student focus group was also convened to further explore student perceptions. Results of the post-learning test revealed that the mean correct answer rate was 93%. Student satisfaction increased from 2.8/5.0 in a traditional approach to 4.1/5.0 in the TOP. Analysis of the focus group discussion revealed further potential areas for improvement. Students proposed that the 'perfect TOPs station' should include: (1) a short introduction to the topic, e.g. two-minute long video, short background text or teacher presentation; (2) bespoke, high quality resources of diverse modalities, e.g. models, plastinated specimens, microscopic slides, conceptual diagrams, radiological images, low-fidelity models; (3) a task which would realistically be achievable in the timeframe provided e.g. solving the clinical problem, preparation of short video demonstration, sketching a diagram; (4) immediate feedback in order to confirm students' learning, e.g. quiz, model answer, chatbot. These findings confirm that working in partnership with students adds value to the development of novel teaching techniques. The preparation of

collaborative, student-centered, engaging TOPs stations is a demanding process which requires time, expertise and experience to develop and refine. This process will be further explored and evaluated in future studies.

Research approved by the Institutional Review Board of the University of Hong Kong (UW19-277).

P2-E17

Religious influence on body donation in Thailand: a recent case from Khon Kaen University

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Body donation is an indispensable part of anatomy teaching and research. While donation is often motivated by altruism, religious belief is one of the factors that influence people towards body donation. In Thailand, body donors are honoured as "great teachers". According to Buddhism, "dana", meaning charity or donation, is a component of the noble eightfold paths that represent certain disciplines that Buddhists follow. A recent passing of Luang Pho Khun, a famous Buddhist monk, has made a measurable impact on body donation programme in Thailand. Upon his passing in 2015, he donated his body to Department of Anatomy, Faculty of Medicine, Khon Kaen University. His action was seen as exemplary by the general public. Donation records at our institution revealed that number of registrants 24 months after passing of Luang Pho Khun significantly increased up to 2 folds (26,499 registrants) in comparison with 24 months before the passing (10,356 registrants). Age and gender differences were noted. Number of donations were higher in females than male by 20%. The age period of 50-59 years old had the greatest rate of donor registrants, followed by age period of 40-49 years old, 60-69 years old, and 30-39 years old, respectively. Our data suggested that recent passing of Luang Pho Khun, has led to a positive impact on body donation programme at our institution. As a result, our institution is not currently facing any shortage of cadavers, despite the mushrooming of medical colleges and the increased demand for cadavers in our country. This research was approved by Center for Ethics in Human Research, Khon Kaen University (No.HE621192)

P2-E20

Why is anatomy difficult to learn? Exploring the views of anatomy teachers and anatomy learners with varying years of experience

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Anatomy education is a key component of medical and healthcare professional education. Successful translation of theoretical knowledge to clinical scenarios is key to desirable healthcare outcomes. However, students often find anatomy difficult to learn and poor retention of anatomical knowledge in medical practice has been reported worldwide. Most studies have focused on perceptions of junior medical students but few examined views from anatomy teachers or students with more experience with the subject. This qualitative study aimed to explore the perceived difficulties in anatomy learning using a grounded theory approach. This approach involves identifying and integrating common themes from the data set and ultimately reaching a theory to explain the observed phenomenon. Individual interviews were conducted with second-year and final-year medical students, junior doctors and anatomy educators (n=16) with informed consent obtained. Regions that were reported as most challenging to learn included: 1) neuroanatomy; and 2) head and neck. Coding themes of prevalent issues included:

1) working memory load; 2) three-dimensional (3D) structures that are difficult to observe in real human body; and 3) translation between dimensionalities (2D to 3D and vice versa). View of anatomical structures being obscured was a common learning difficulty amongst different cohorts. Novice learners have never seen real human anatomical structures whilst more experienced learners and even educators sometimes struggle to identify structures due to their sizes or locations. It becomes challenging to learn 3D structures solely from 2D illustrations and this increases cognitive load as learners need to expend more effort to imagine what real structures look like. Being able to see and identify real structures is an important component to students' learning. This is missing with structures such as nerves and vessels in the head and neck region. Future study will look at the impact of object visualisation ability on students' learning of anatomy.

P2-E22

Assessing the Changes in the Body Donor Profile Over 10 Years of a Body Donation Program in Brazil

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The use of bodies for research and teaching purposes is well established worldwide. In Brazil, the Body Donation Program (BDP) at the Federal University of Health Sciences of Porto Alegre (UFCSPA) is a pioneer promoting anatomy education focused on voluntary donation. To implement such a project, it is necessary to improve population awareness regarding the possibility of body donation. Thus, this study aims to analyze the changes in the donors' profile registered in the BDP since its creation to ensure an updated marketing strategy focused on the target audience. The study was approved by the Research Ethics Committee of UFCSPA (No. 721/2008). All data were collected from a specific form filled out consensually by the donors at the time of registration. The questions included demographic information and source of knowledge about the program. The analysis included 736 registrations, from January 2009 to December 2018. Then, it was compared the first and last three years of BDP, the periods of 2009-2011 and 2016-2018, respectively. The first triennium included 141 registrations, an average age of 62,9 years, 68% were women, 42% had income above three minimum wages, 21% heard about the project from friends or registered donors and 40% from press. The last triennium had 315 registrations, obtaining an average age of 64,5 years, 71% were women, 38% had above three minimum wages 34% heard about the program from other people ($p<0.05$) and 42% from press ($p<0.05$). Thereby, the donor's profile regarding income and sex is sustained. Although the press corresponds to a greater scope percent, the present study identified a statistically significant increase in disclosure among donors and friends. The finding suggests changes in the reach of the target audience, since the word-of-mouth marketing has become an important informational factor for the population, contributing to body donation campaigns in the country.

P2-E23

Whatsapp and Video Class as an Innovative Strategy in the Teaching-Learning Process

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The use of innovative resources to convey knowledge in a different way, that achieves the desired goals, is in a process of increasing and rapid progress. The search for active methodologies or more appropriate teaching - learning techniques should be a constant in the thinking of those involved in teaching, since the academic profile changes systematically throughout the generations. The objective of the present work is to describe the strategy and innovative methodological tools in the teaching-

learning process used in the 3rd semester of the Pharmacy Course of 2019. Methodology: The procedure used was to analyze the authors' perceptions regarding the activities developed by the group of a study created in the WhatsApp Messenger application and video class, developed in the first half of 2019, where clinical histories were presented with cases of organic dysfunctions of fictional patients, as well as reflections and questions about the subject. The instantaneous and automatic format of the WhatsApp Messenger application template provided access to information to all participants in the group, being they active or passive participants in the time and space they desired. The authors' perception was that the strategy guided by two tools, that is, the creation of fictional characters with organic dysfunctions to stimulate interest and discussion in the WhatsApp Messenger application study group was valid for the teaching- learning as engaging, interactive and motivational methodologies.
As there was no data collection, it was not necessary to submit to the ethics committee.

P2-E24

Humanization of Anatomy Laboratories of the São Francisco University: A Proposal for Students of Health Courses

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It is a fact that when it comes to thinking, changing routines and intellectual overload in your journey of study, there are many psychological processes. Studies have stated that the first contact with death as a source of discomfort and distress may not be explicit, but are identified in classroom conversations. The objective of this study was to propose a humanized environment during the anatomy classes that take place at the Center for Anatomy Studies (CEA) of the University of São Francisco. For this, in the planning of the construction of the CEA, the teachers, and the local team, elaborated an architectural design of the practical classrooms aiming at a comfortable, illuminated environment, decorated with anatomical arts that made the environment motivating, joyful and attractive. In the central hall contains an assembly with major events in the history of anatomy. The internal walls of the laboratories present photos that give shine and lightness to the environment. During the visits and the first practical activity, the reading and reflection on the Unknown Corpse Prayer are performed as an oath of respect. After the first quarter of 2019, from the authors' perceptions, it was noticed that the environment is more pleasant and stimulating, being a factor that motivates the stay in the place. Therefore, the CEA model allows a lofty reception and approach of the presentation of the anatomy to the academic through a humanized and holistic contact, focusing on death as the existence of life. As there was no data collection in this study, it was not necessary to submit to the ethics committee.

P2-E25

Blended Learning Program in Human Anatomy for Undergraduate Medical Students

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Anatomy is the foundation of medical training but many students find it difficult. Flexibility and innovation in educational methods are urgently required. To inculcate a behavior of self-directed learning, blended learning methodology (BLM) in anatomy teaching was initiated.
After approval by institutional review board and obtaining informed consent, the study was conducted on 1st year medical students (n=100). Faculty and students underwent orientation to BLM and their responsibilities. BLM was designed

to have an online, a face-to-face and a learning activity component. Five online modules were prepared and access opened for students one week prior to the classroom teaching. During the face-to-face component, students clarified doubts and did hands on dissection with faculty facilitators, followed by either one or two relevant clinical activities. MCQ tests were administered to the students at the end of each BLM module and five non-BLM topics.

BLM was well received by students and faculty and found to improve student performance. Most of the students enjoyed the BLM learning experience (81%), showed increased self learning (80%) and became aware of their self learning capacity (81%). Many students developed an increased interest in anatomy (81%) and majority expressed interest in being taught by BLM in future also (76%). Faculty (n=15) found BLM enjoyable (12/15) and would like to be involved in BLM teaching in the future (10/13). The mean satisfaction score of BLM program (out of 10) was 8.14 +/- 1.15 and 7.8 +/-1.699 for students and faculty respectively . The means scores of MCQ tests for five BLM versus non BLM topics were compared and statistically significant increase in scores was noted for BLM 2, 3 and 5 (p value <0.001).

Student learning is multifactorial, depending on individual learning styles. Blending different modes of teaching is essential to improve outcomes.

P2-E26

Can students' anatomical knowledge and physical palpation skill confidence be improved by functional 3D Printed Foot models?

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Palpation skills in the clinical health sciences is an important skill set facilitating clinical reasoning and accurate clinical diagnosis. Comprehensive knowledge of anatomy and its relevance to disease, pathomechanics and variant presentations is needed. While commercially available static anatomical models exist for educational purposes, these models lack functionality, which could assist learners to further understand anatomical landmarks and movements that occur in the real world. Many newly developed resources are mostly found on digital devices, thus students learning palpation skills have to imagine what is physically palpated. Therefore, we developed three identical and functional 3D printed foot models with different graded densities of transparent and opaque material. The objective of this project was to evaluate the effectiveness of these models as a teaching tool in a clinical palpation skills workshop. Ethics approval (H10388) was gained from the Human Ethics Research Committee (HREC) at Western Sydney University. Seventeen podiatry students (first and fourth year) participated in the project. Students rated their experience through a Likert-scale survey, indicating that the 3D model improved their clinical knowledge and palpation skills. Qualitative data from the open-ended questions indicated three unique themes 1) Learning through comparison between models, 2) functionality of models, and 3) confidence in learning and translation to practice. Overall the students thought that the 3D printed models were much better than the commercially available models, allowing greater functionality and palpability for translation into practice.

P2-E27

The Brachial Plexus model: a novel interactive model using 3D printing

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During the physical examination of patients suffering from trauma to the upper extremity,

mapping of injuries can aid in diagnosis of brachial plexus injuries. Thus, an understanding of the distribution and function of the brachial plexus and its individual nerves is of essence in clinical practice to ensure accurate assessment of injury, to prevent further damage and assess any remaining function. The current brachial plexus model aimed to assist students in understanding the formation of the brachial plexus through creating and labelling each of the parts of the brachial plexus. Ethics approval was received from the Human Research Ethics Committee (HREC) at Western Sydney University (H12966). Students enrolled in two units (Appendicular Skeleton, Functional Anatomy) which run in different course streams, were given access to the model during their time in the anatomy lab. Students were then asked to provide feedback through a three point Likert scale questionnaire and two open-ended questions. 56 responses were eventually returned. 91% of the students agreed that the model was a valuable learning tool while 85% thought that is was an effective model in translating the information between theory and cadaver thus deepening their understanding. Qualitatively, the themes that emerged included the positive aspects of colour, structural arrangement, and kinaesthetic involvement, while some suggested a larger model. Our current brachial plexus model has assisted students in their learning of the formation of the brachial plexus, and has ultimately been effective in providing an understanding of structures and relationships within the nerve plexus thus allowing a deep learning approach and negating pure memorization.

P2-E28

I spy…. Development of a functional eye model to visualise the actions of the extraocular muscles

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The actions of the extraocular muscles and corresponding movements of the eye are conceptually difficult topics to learn. Students are generally taught the mechanisms of eye movement through computer simulation, reading and still images. However, the concept still confuses students and they have difficulty understanding the movements created by the respective muscles. Students have previously reported the value of using a functional eye model to understand the actions of the extraocular muscles. However, the previously developed model had limitations including the prioritisation of movement over anatomical accuracy. The model also did not fully demonstrate the functions of the superior and inferior oblique muscles. Thus, in light of these limitations and comments from students, we have now produced an anatomically proportional, functional eye model using 3D design and printing technology. The model demonstrates the actions of all extraocular muscles, including the super and inferior oblique muscles, while relating the structures of the orbit to anatomical landmarks. This study describes the step by step method used to develop the improved functional eye model and important factors to consider in maximising the functionality of such models. The model is due to be used in two different institutions in units that teach the movements of the eye. Future studies will establish students' perceptions of the value of this model in learning the movements of the eye.

P2-E29

The origins of neurophobia: opinions of medical students formed on pre-university exposure to neuroanatomy

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It is well established that neurophobia affects medical students and practicing clinicians worldwide. Poor teaching experiences are known to contribute to neurophobia but it is unknown at what stage of medical education these experiences occur. By surveying 1st year medical students this cross-sectional study aims to identify what opinions are formed based on pre-university exposure to neuroscience.

All first year students from two UK medical schools (University of Southampton and University of East Anglia) were approached in their first 2 weeks of study to complete a bespoke questionnaire designed to examine their attitudes towards neuroanatomy.

223 students returned the survey with mean age being 19.4 ± 2.6 years. 185 (84.5%) believed studying neuroanatomy was either difficult or very difficult and 172 (78.9%) of the respondents perceived neurosurgery and neurology to be more challenging than other medical specialties. 203 (93.5%) students believed that society perceived neurology and neurosurgery to be difficult subjects and this made 97 (47.8%) more worried about learning it. 23 (9.9%) students had been informed neuroanatomy was either difficult or very difficult by friends and family. 128 (58.7%) of those surveyed indicated the volume of work required for neuroanatomy made them either worried or very worried.

Medical students' attitudes towards neuroanatomy are negatively influenced by their experiences even before they begin university. Students perceived neurosurgery and neurology to be more challenging than other medical specialties as well as believing the public also share this view. It is likely that pre-university opinions of neuroanatomy are multifactorial and require further investigation so that they can be reversed at medical school.

This study was approved by the Faculty of Medicine Ethics Committee.

P2-E30

The HistoHustle: Supplemental Histology Sessions to Enrich Student Learning & Improve Exam Performance

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Anatomical education research is aimed at advancing our understanding of learning outcomes, however, less research has evaluated supplemental resources for reviewing anatomy content, such as practice questions and review sessions. Interestingly, these resources are where students frequently spend significant study time. Hence, it is important to evaluate the effectiveness of these resources as a way to support student learning. One such resource offered at the KCU College of Osteopathic Medicine is the HistoHustle, a review session developed to increase student engagement and retention of Histology content in our medical curriculum. In the sessions, a faculty facilitator demonstrated a virtual histology website (open resource) as well as histological images from the Virtual Microscopy Database (VMD, courtesy of the AAA). Histological context for each slide was reviewed, as well as how to evaluate regional characteristics of a tissue at multiple magnifications. First- and second-order questions, which addressed basic identification and tissue/cellular function, were included. The session concluded with higher-order, board-style practice questions that required synthesis and evaluation of lecture material. Success of the sessions was directly tied to demonstrating how to make judgement calls for a given structure and/or tissue, and more importantly, providing feedback and visual cues as to how to correctly identify specimens. Student comments from voluntary course evaluations has been overwhelmingly positive: students noted the helpfulness of an extra 'pass' through the content, the willingness of faculty to provide extra study resources, and an increase in exam preparedness. Overall, students have learned to create 'mental' histological checklists to improve image identification, ignore exam distractors, and narrow down answer options. Future goals include qualitative analysis of metacognitive changes in high versus low performers that

attend the HistoHustle sessions. Sharing the development of these resources may encourage other programs to develop new resources to improve student engagement and retention.

P2-E31

An Honours Programme Education: reinforcement of practical neuroanatomy teaching by medical students

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Historically student assistants have helped the academic staff in the dissection room. Often no structured supervision is organised whereby the quality of teaching provided by the students is closely monitored. Moreover, student assistants were not asked to actively contribute to innovation projects addressing content, methodology or organisation of anatomy labs.
Each year we select 6 medical students (who successfully passed the neuroscience module) to start a 2 year Honours program education dedicated to tutor neuroanatomy lab sessions. During a summer course the selected students get training by experts about the multidimensional responsibilities of the peer tutor and are taught a mix of generic tutoring skills. Next, they are challenged with specific problems in the existing neuroanatomy labs for which we ask them to propose solutions.
For example, we asked them to examine how to make efficiently use of the anatomage table to acquire 3D insights into the topography of the lateral ventricles before starting the lab sessions.
At the end of the summer course, the students present their insights on how to tackle the given problems. After feedback with the anatomist and educational expert they further develop their innovation project. In order to provide the 6 students with sufficient background knowledge, an in-depth training is offered with comparative brain anatomy in addition to clinical neuroanatomy, with input from the veterinary and neurosurgery department. Next to their contribution in the lab sessions for 5 different study programs, HPE students contribute to science communication on brain anatomy for a lay audience. After finishing successfully the program, with submission of a written portfolio illustrating their contributions, the students get a certificate equivalent to 15 ECTS credits.
Evaluation of neuroanatomy labs improved substantially after the introduction of this HPE program. The local ethical committee of the University Hospital Ghent approved the body donation program.

P2-E32

Attitude of Indian students towards cadaveric dissection during anatomy dissection sessions in their first year of medical training

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Anatomy has historically been a cornerstone in medical education regardless of nation or specialty. Many medical institutions use different learning approaches in teaching gross anatomy in both large and small teaching groups including dissection, interactive multimedia, procedural anatomy, PBL, clinical anatomy and imaging. This study aims at understanding the opinions of the students about the learning of anatomy through the process of cadaveric dissection.
The study was conducted on 80 medical undergraduate students in their fourth semester who volunteered for the study. Ethical clearance was taken before commencement of the study. In the current curriculum these students had completed their cadaveric dissection sessions six months ago at the time of study. A Questionnaire based on Likert scale was used for evaluation of the cadaveric dissection. The majority of students

agreed with positive perceptions of cadaveric dissection.

According to our study most of the students stated that cadaveric dissection is important for the learning of anatomy (90%) and most of the students contemplated that cadaveric dissection is essential for the learning of medical sciences as a whole (83.5%). Majority of the participants favored (73%) that the role of anatomy is critical in clinical learning and the students were able to perceive a three-dimensional picture of the human body after the dissection sessions (64%). When probed for the response, the students also had sentiments like nausea, fear, feeling faint and excitement etc. Likewise, the students were neutral about the unpleasantness they felt in touching.

The current challenge in medical curriculum in recent scenario is to reinstate more effective teaching-learning approaches while preserving the valuable principles of conventional dissection. Such surveys revealing perception of the primary stakeholder i.e. undergraduate students regarding dissection will certainly pave the way for policy makers and facilitators to improve the design and practice of curriculum.

P2-E33

Structure and Function of Musculus Esternalis Based on an Anatomical Study

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The sternalis muscle is a normal anatomical variant of subcutaneous thoracic location, lateral to the sternum and superficial medial to the pectoralis major muscle. It could be unilateral or bilateral, with unknown function. Based on its fixations superior to the second costal cartilage and sternal manubrium, and a lower fixation close to the costochondral border, it has been proposed that its function is accessory inhalation, allowing the elevation of the lower thoracic cage. The objective is to present a biomechanical function option based on the vectorial decomposition, from a bilateral finding of the sternal muscle in the anatomy laboratory of the University of Caldas (Colombia).

We used the vectorial decomposition method (this consist at the decomposition of a resultant vector in two components in X and Y space planes). The results are represented based on the fixations of the bilateral sternal muscle found in the Anatomy laboratory to determine its biomechanical function.

We find that the sternal muscle presents lower insertions in the seventh ribs, which represented by generators of movement, gives a resulting vector on the axis of the ordinates that corresponds to a costal elevating function, which helps in respiratory inhalation mechanics.

There are few studies on the sternal muscle and there is no evidence of its function. By means of vectorial decomposition in two planes, it is proposed that its function is accessory inhalation. In conclusion, the sternal muscle has an accessory inhalation function.

For ethical and legal considerations, the principles of the declaration of Helsinki were followed, respecting the confidentiality, dignity and integrity of the specimen, enshrined in Resolution 8430 of the Ministry of Health of Colombia.

P2-E34

The use of porcine corrosion casts for teaching 3D human anatomy

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In teaching and learning human anatomy, alternative methods must often be used to demonstrate particularly delicate structures. Because of easy organ accessibility and high teaching potential, we decided to prepare corrosion casts (CCs) of various porcine organs (liver, kidney, lung, spleen, small intestine, heart) that otherwise would be wasted—pigs are bred in our biomedical center and are sacrificed for a variety of research topics. Corrosion casting with Biodur E20® Plus (Heidelberg, Germany) appeared to be valuable for teaching and learning both the macro- and micromorphology. Biodur E20® is temperature-tolerant, slightly flexible and chemically resistant. After solidifying (24 hours), Biodur CCs can be stored in alcohol to prolong the pre-corrosion period or to prevent voluminous corroded CCs from molding. Based on our feedback questionnaires (N = 30), assessments of casts with a stereomicroscope, (micro-)computed tomography and/or scanning electron microscope as well as highlighting structures using color coding helps students to better understand how the structures that they have observed as two-dimensional images actually exist in 3D. Reconstructions of cast hollow structures from scans and videos also aid in the understanding of clinically relevant structures. The casting protocol and teaching manual we published can be adjusted to different technical capabilities also for other biological science classes.

This project was supported by Charles University in Prague (Grants SVV–2019 No. 260392 and 260390; Research Fund Progress Q37 and Q39) and by the National Sustainability Program I (NPU I; No. LO1503) provided by the Ministry of Education, Youth and Sports of the Czech Republic, by the European Regional Development Fund – Project „Application of Modern Technologies in Medicine and Industry" (No. CZ.02.1.01/0.0/0.0/17_048/0007280), and by the "Centre of clinical and experimental liver surgery" UNCE/MED/006.

All animal procedures were prepared and performed under the law of the Czech Republic compatible with the legislation of the European Union.

P2-E35

Room-Temperature Resin Casting: a Low Cost Effective Tool in Teaching Cross Sectional Human Anatomy

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Traditionally gross anatomy teaching relies on cadaver dissections. Medical faculties are shifting towards novel teaching methods due to the high cost involved in maintenance of cadaveric dissections. At Department of Anatomy, Faculty of Medical Sciences(FMS), University of Sri Jayewardenepura(USJP), anhydrous human tissues were mounted in solid resin casts, to study detailed Anatomy. The aim was to develop a durable, low cost technique to preserve human cross section slices with its detailed anatomy. Human specimens were taken from the cadavers donated to the Department of Anatomy, FMS,USJP with written consent. Tissues were initially fixed in 10%formalin for 5days to stop the decaying and decomposition. Cold 99.9% acetone series was used to dehydrate the tissue. Weekly acetone baths were changed for 4 and 6 weeks for the cross-section of heart and foot respectively. Dehydrated parts were exposed to sub-atmospheric pressure in a clear resin to replace acetone. This process took nearly 1 week. Final specimens were embedded in layer by layer in clear resin after mixing with the catalyst at room temperature, which will polymerized into a solid resin cast. This is an appropriate method for preserving human body cross-sections at specific vertebral levels. In this invention, dehydrated human tissues were embedded in a clear synthetic resin cast, while preserving the original shape and volume. These casts have zero exposure to formalin during handling. The specimens are more durable than the specimens preserved with routine methods in Sri Lanka. As the tissue waste is low, the preservation and maintenance cost of cadavers is less. Currently these cross sectional resin casts are used for teaching/learning anatomy at FMS, USJP.

Undoubtedly the detailed anatomy is best learned by cadaver dissections. Resin casting is a cost effective successful supplementary method that could be used by students to learn cross-sectional Anatomy without being exposed to formalin.

P2-E36

The Integration of Traditional and Innovative Methodologies in Teaching Gross Anatomy

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Cadaver dissections have used for centuries for teaching/learning gross anatomy all over the world and play a key role in understanding the three-dimensional(3D) relationship between the structures in the human body. In the past few years, the rapid development of digital technologies became an integral part of medical education. Department of Anatomy, Faculty of Medical Sciences(FMS), University of Sri Jayewardenepura(USJP), Sri Lanka has effectively incorporated the interactive 3D-animations into traditional cadaver dissections. Initially, four 55inch 3D LED panels were installed in the dissection halls and networked. Commercially available recommended Anatomy software and videos were purchased. Initial 15 minutes of the dissection time, a lecturer, gives an overview of the area to be covered for the particular dissection session utilizing the 3D software. Thereafter students are directed towards routine cadaver dissections. Cadavers were donated with consent prior to the death for teaching and research. Last 15minutes of each dissection period, the summary of the relevant dissection is shown using videos. Whenever an interesting anomaly/anatomy is found, it is telecast using the LED panels. Once a week an applied Anatomy cadaver-based teaching session is conducted by an invited clinicians. Ethical clearance was obtained from the Ethics Review Committee, FMA,USJP and feedback was taken to assess the effectiveness of the Anatomy teaching in the dissection hall using 328 pre-clinical medical students belongs to 3 batches. 90.2%(296/328) have stated that overall changes have helped to understand and recall the specific Anatomy easily. 3D animations on the LED panels(85.0 %[279/328) and applied anatomy sessions by clinicians(88.4%[290/328]) were stated as very useful and they were highly attracted initiatives among students. Preliminary results suggested that interactive 3D digital animations and cadaver-based applied anatomy sessions are more efficient than dissections alone and has played a major role in developing the interest and motivation among students towards understanding Anatomy.

P2-E37

Learning Styles And Approaches Among Medical Undergraduates And Pre-Intern Doctors

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Medical education is an ever-evolving process. Gaining the required knowledge and skills within a specified period of time to become a competent doctor is a challenge. The shift from teacher-centered and subject-based teaching to the interactive, problem-based, student-centered learning is an important concept in medical education. This study evaluates the learning styles using VARK questionnaire among 238 and learning approaches using ASSIST questionnaire among 138 Medical Undergraduates(MU) and Pre-intern doctors. Study sample for VARK consisted of 67.2%(160/238) MU and 32.8%(78/238) pre-interns. The total male(72/238) to female(166/238) ratio was 1:2.3. Majority80.7%(192/238) had unimodal learning styles. Majority of the MU[78.1%(125/160)] and

pre-interns[85.8%(67/78)] were unimodal learners. Similarly, the majority of males 81.9%(59/72) and females 80.1%(133/166) were unimodal learners. Among unimodal learners, the majority had verbal[30.2%(58/192)] and auditory[28.6%(55/192)] learning styles. Multimodal learners had a combination of auditory-kinesthetic 28%(13/46) and verbal-kinesthetic 26%(12/46) learning styles. From the total of 138 participants filled ASSIST, 33.3%(46/138) were males and 66.6%(92/138) were females. The sample consisted of 77.5%(107/138) MU and 22.5%(31/138)pre-interns. Among participants, the predominant learning approach was Strategic approach(SA) 78.3%(108/138) while Deep-approach(DA) was 15.2%(21/138) and Surface apathetic approach(SAA) was 6.5%(9/138). Majority of MU[77.6%(83/107)] followed SA, while 16.8%(18/107) were DA and 5.6%(3/107) had SAA. Similarly, the majority of pre-interns[80.6% (25/31)] followed SA while DA and SAA learners were equally distributed[9.7% (3/31)]. Majority of males 69.6%(32/46) were SA learners and the rest were DA[21.7% (10/46)] and SAA[8.7% (4/46)] learners. Learning styles were similar among MU and pre-intern doctors. Besides, comparable results were observed in local and international studies. Encouraging multimodal learning styles would help to develop a better undergraduate medical curriculum. Learning approaches of MU have not significantly changed over a five year period of University education. The ethical clearance was obtained from Ethics Review Committee, Faculty of Medical Sciences and informed written consent was obtained prior to the study.

P2-E38

Comparing junior doctors' performance on cadaver vs imaging based assessments: Have medical schools got the balance of the their syllabus right?

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The use of cadaveric specimens to teach anatomy has long been the gold standard of teaching at medical schools in the UK and US. However, exposure to cadaveric teaching becomes much scarcer as a graduate doctor. In clinical practice most junior doctors encounter applied anatomy through clinical examination and interpretation of medical imaging. This forms a much smaller part of the anatomy syllabus in most medical curricula. This study investigated how qualified doctors from a range of institutions and grades of training up to ST3 were able to demonstrate neuroanatomical knowledge when applied to both cadaveric spotter tests and a medical imaging-based exam.

32 doctors from 24 UK hospitals took part in a national neuroanatomy competition over a two-year period. On average, doctors scored 11% higher on the imaging paper compared to the anatomy spotter (61.48% vs 50.28% $p<0.001$). The median rating doctors gave their medical school training for preparing them to interpret neuroanatomy-based CT and MRI imaging was 7 out of 10. 65% of candidates taking part wanted to be neurosurgeons.

Although cadaveric specimens are an incredibly useful resource for teaching anatomy, junior doctors apply most anatomical knowledge from their training through the interpretation of imaging, often containing pathology. However, as prospective neurosurgeons, recognition and appreciation of real-life anatomy is important. This might suggest that that current neuroanatomical medical training is unbalanced, with undergraduates not receiving enough image-based anatomy and junior doctors not sustaining their training opportunities using cadaveric material.

This study was approved by the Faculty of Medicine Ethics Committee University of Southampton.

P2-E39

Practical sessions or Lectures: Where are Near-peer teachers best utilised in an anatomy curriculum

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Near-peer teachers (NPTs) have been shown to be a useful asset to teaching teams in the context of anatomical education for medical students. However, as with all resources it is imperative to consider the setting in which they would be best utilised. Anatomy teaching is typically delivered via a combination of practical sessions with cadaveric specimen demonstrations and more theoretical sessions for delivering abstract concepts.

A cohort of second-year medical students (n= 208) were taught by NPTs on their nervous and locomotor 2 module. The cohort was exposed to NPTs in both practical lab-based sessions and in small-group lectures. Students were then surveyed about their opinions of the teaching they received in each setting using a Likert style questionnaire. (response rate = 100%).

Students rated the overall teaching as better in the laboratory setting across all criteria apart from 'Enjoyment'. They rated the 'use of their time' and the 'amount they had learnt due to the NPTs' as highest in the lab sessions and thought the 'presence of NPTs' was more worthwhile. They also rated the 'teaching methods used' in the lab as higher than in the lectures. These criteria yielded a significant difference ($p < 0.01$ Kruskal Wallis). There was no significant difference in ratings of how much they enjoyed the sessions. This was confirmed with Dunns multiple comparison. The mean ratings for all criteria in both groups were high (≥3.8 out of 5).

Students have a more positive experience being taught by NPTs in a practical lab setting than in lectures. This may be due to students accessing NPTs more in this setting. Lab sessions tend to generate more questions and students receive more one to one and small group attention.

This study was approved by the Faculty of Medicine Ethics Committee University of Southampton.

P2-E40

Using ultrasound to enhance live anatomy knowledge in the undergraduate medical curriculum

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Ultrasound imaging offers the opportunity to learn live anatomy, which is increasingly important in the clinical setting. In this educational project, a 3rd year medical students' initiative to introduce a new abdominal ultrasound course of normal anatomy for their 2nd year peers has been followed. The course was approved by the Curriculum Committee. After completion of a dissection course of 120 hours, twenty 2nd year medical students were offered an optional course by eight 3rd year near-peer-teachers supported by an experienced anatomy teacher and experts in abdominal ultrasound who prepared and coached the near-peer-teachers for their role. The course was delivered by the peer-teachers to groups of five students in 6 x 3 hours blocks covering the following topics: (1) Major abdominal blood vessels, (2) biliary ways and pancreas, (3) liver, (4) spleen and abdominal urogenital organs, (5) FAST (Focused Assessment with Sonography for Trauma), (6) Revision and practical exam. The course was evaluated anonymously through a standard questionnaire for students, an online questionnaire for students and another one for the peer-teachers. Additionally, written feedback was evaluated. The course received excellent

feedback for content and delivery from the students, as well as from the near-peer teachers. At the end, all students were able to handle various models and brands of ultrasound machines, knew well how to perform a basic ultrasound investigation of the abdomen, and recognized all relevant anatomical structures. Also the peer-teachers improved their ultrasound skills, as well as their teaching skills. Therefore, this course will continue to be offered in future semesters, organized and delivered by near-peer teachers. We conclude that ultrasound imaging can be used at an early stage in the medical curriculum to enhance live anatomy knowledge. In addition, student participation in the design and delivery of courses should be more frequently considered in the future.

P2-E41

Anatomical Draw-It and Do-It! Simplifying the Complex and Unseen

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Learning anatomy through the act of drawing and doing are powerful ways to make visible the unseen and to simplify the complex. Research shows drawing encourages learners to engage in knowledge construction, fosters conceptual change and incites meaningful understanding. This study aimed to elucidate; how Year 1 medical students engaged with 'Draw-It' and 'Do-It' tasks; how the tasks impacted upon anatomical learning; and which types and styles of task were most beneficial to learning. Consequently, all Year 1 (2018-2019 cohort) medical students (n=206) at Warwick Medical School participated in twenty 'Draw-It' and 'Do-It' sessions each 30-minutes in length specifically designed to demonstrate anatomical structures, concepts and functions across multiple anatomical systems and regions. 'Draw-It' activities included an instructive text and framework that guided students to create their own drawing, and 'Do-It' activities required the hands-on manipulation of a conceptual model or object. The tasks focused on topics that students traditionally find challenging, for example, the pericardial coverings of the heart (Draw-it) or constructing a simplistic model of the pelvic floor and perineal pouches (Do-It). Students voluntarily completed an anonymous reflective questionnaire and a subset participated in a semi-structured interview. Results showed the majority of students felt the activities exposed their areas of misunderstanding, challenged them to visualise anatomy in a simpler way, increased their ability to remember complex subjects/concepts, and required them to draw upon material previously taught in the course. Although some activities were described as simple, many students felt the sessions positively 'took away the mystery' surrounding certain complex subject areas, made drawing an 'approachable skill', and encouraged them to think about the 'why behind their anatomical learning'.
Ethical approval was granted by the Biomedical and Scientific Research Ethics Committee (University of Warwick)

P2-E42

An effective teaching tool for understanding the complex embryological concept of tongue development for postgraduate clinical anatomy students

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Embryological development of the tongue is a dynamic and complex process that requires learners to understand mechanisms of pharyngeal arch development and visualise complicated 3D transformations of form and shape during key developmental stages. Most undergraduate and postgraduate embryology teaching delivered within the Centre for Biomedical Sciences Education in Queen's University Belfast is achieved by 2D methods. Despite valid learning achieved via these methods, students commonly report an absence in understanding and visualisation of the processes involved. Multimodal, active learning has been shown to increase knowledge,

understanding and retention over more passive learning techniques, and therefore, some kinaesthetic learning has been introduced. Postgraduate clinical anatomy students (n=23) were given a lecture on facial development, including development of the tongue, with incorporated images and short animated videos. Working in small groups, students were given Play-Doh© and tasked with constructing 3D representations of the tongue from the pharyngeal apparatus at 5 weeks and 5 months' development. Students were able to construct important structures such as lateral lingual swellings, tuberculum impar, copula and the epiglottal swelling and demonstrate how these structures develop into anterior and posterior parts of the tongue, as well as highlight from which pharyngeal arch tongue elements are derived. Feedback was provided from a minute paper using Likert scale questions and free text. The task received positive feedback with 74% (n=17/23) of students stating that the exercise aided their understanding and learning. Positive comments included that students were better able to orientate and visualise the sequential development of structures. Six participants (26%) questioned the usefulness of the task and felt it did not aid understanding. Therefore, use of such models in embryology teaching can be used as additional learning resources to supplement learning and improve teaching effectiveness of complex subjects. No ethical approval was required for the pilot study.

P2-E43

The Value of Extracurricular Academic Competitions in the Development of Anatomical Education

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The gradual reduction in curricular time dedicated to clinical anatomy gives little opportunity for students to develop an academic interest in, or explore knowledge of the subject. It is feared that this reduction will decrease the number of students pursuing careers centred around clinical anatomy, eg. surgery. For the past 7 years the University of Southampton has hosted the National Undergraduate Neuroanatomy Competition (NUNC) giving medical students an opportunity to pursue their interest in neuroanatomy. We propose that engagement with competitions such as the NUNC are valuable in inspiring interest and development of anatomical knowledge in those that attend.

To assess this hypothesis we collected data from the 2019 cohort. Of 125 attendees, 66 consented for their answers being used in research. This questionnaire used a Likert scale to assess delegates' level of agreement with the following statement: 'Preparing and participating for NUNC has improved the standard of my neuroanatomy knowledge beyond what I would learn in my own medical curriculum' (1 =disagree, 10=agree). We concurrently assessed the perceived value of feedback from the NUNC on development of neuroanatomical knowledge (1=very little, 10=very much).

The median obtained from the assessment of student knowledge was 9 with an interquartile range (IQR) of 2 indicating strong agreement with the statement. Delegates felt that performance feedback was valuable for further development of their neuroanatomical knowledge with a median of 9, IQR of 2.

We propose that engagement with competitions such as the NUNC are an effective way to improve and strengthen student anatomical knowledge through exposure to content beyond the curriculum, encouraging preparatory effort before the competition and through feedback offered after. We propose that, in order to counteract the reduction in curricular time, similar competitions should be used to stimulate interest in different areas of clinical anatomy.

Ethics ID: 9351

P2-E44

Student Perceptions of the Value of Academic Competition in Career Development

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Over the past 7 years the University of Southampton has run the National Undergraduate Neuroanatomy Competition (NUNC) giving medical students across the UK and Ireland an opportunity to challenge their neuroanatomical knowledge and exhibit an interest in this competitive specialty. In this 7 years we have explored student perceptions of the value of academic competition in their career development through delegate quotes and questionnaires.

Of the 125 delegates attending the 2019 competition, 66 consented to research. A questionnaire using a Likert scale was used to assess how likely delegates were to add participation at NUNC to their portfolio/CV (1=very unlikely, 10= very likely). We also assessed how likely they would be to mention their result in this competition in a clinical interview (1=very unlikely, 10=very likely) and the specialty they wish to work in in the future.

Over half of delegates had a desire to work in neurology or neurosurgery. Delegates were very likely to mention placing (receiving a distinction, runner up or winning) in this competition in a clinical interview (median=9, interquartile range (IQR)=2) whilst being slightly less likely to add participation to their portfolio/CV (median=8, IQR=3.75). This may indicate that placing in a competition is of more perceived value than participation.

Thus, the majority of delegates see this academic competition as beneficial to their career. The positive inclination to mention placing at NUNC in a clinical interview, an event which for some delegates will not occur for at least 4 years, suggests that the value of participation is lasting. We propose that the use of academic competitions is perceived as a positive tool for career development and it would be beneficial to assess if this perceived value is translated to actual value in career development. Ethics ID: 9351.

P2-E46

Medical student and trainee authored publications in anatomical education research studies

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Authors' roles in scientific articles are well studied but no studies are present that investigates student and trainee authors in anatomy education articles. Investigating the prevalence of student and trainee (ST) authors in an anatomical education journal and analyzing trends by years were aimed. The study was exempt of ethical approval at our institution. Articles published in Anatomical Sciences Education (ASE) had been investigated. All articles published between January 2008 and December 2018 were reviewed retrospectively. Article types stated in journal's guidelines were noted and ST authored articles were determined. Differences in article types, annual trends, and average citations for ST and non-ST authored articles were evaluated. Out of 678 published articles in ASE between 2008-2018, 591 met the study criteria. Medical students, trainees, and both were authors in 93 (15.7%), 47 (8%), and 9 (1.5%) articles, respectively. A total of 2169 authors were determined. Among these, 82 (3.8%) were trainees and 177 (8.1%) were

medical students. There were no significant (p=0.56) differences between ST and non-ST authored articles for article types. Similarly, annual trends in number of ST authored articles were not different (p=0.24) between 2008 and 2018. Although the number of citations to ST authored articles were higher (mean:17.9) than non-ST authored articles (mean:13.8), the difference did not reach significance (p=0.14). The annual number of ST authored articles published in ASE has not changed since 2008. Conversely, there is an increasing trend for ST authored articles in medical education journals over the years. In order to encourage medical students and trainees to conduct anatomical education research, it may be necessary to investigate possible causes for the lack of a similar trend in ASE articles. However, the high average number of citations to ST authored articles may imply that students were directed to higher quality research.

P2-E47

A pilot survey on student opinions of a sectional anatomy elective with play-dough modelling

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Sectional anatomy education is usually formatted as comparison of cadaveric sections with radiologic images. This classical method has a slow learning process, often fails to simplify complex anatomic relations, and frequently is not student centered. Play-dough modeling have been introduced as an effective low-fidelity alternative method. Here, a pilot survey on opinions of third year medical students regarding a sectional anatomy elective using play-dough modeling is presented. Parallel to the spiral integrated curriculum, fourteen two-hour practical sessions were distributed within the respiratory (n=3), cardiovascular (n=2), digestive (n=2), urogenital (n=3), locomotor (n=2), and nerve/sense (n=2) modules. Tandem student teams were provided with colored play-dough and were asked to construct a given region or organ. An instructor modelled the same topic and guided the teams during sessions. At the end of sessions, sections of different planes were obtained with instructor supervision and each section was compared with relevant radiologic images followed by instructor and peer feedback. After obtaining administrative approval (date:04/04/2018; number:165015), students of 2018-2019 academic year (n=22) were informed about the pilot study and asked to fill out an 8 item survey after providing written consent. Students expressed that the method simplified the sectional anatomy of given regions, facilitated knowledge retrieval, was amusing to participate, was student centered, and was an effective way of learning. Conversely, the students also needed preliminary preparation and adequate references. The majority of the students opined the integration of play-dough modeling into the curriculum of both second and third years. Despite positive student feedback, this intervention was limited to groups of 20 students due to low number of trained instructors. Therefore, it may be more suitable for medical programs with fewer students. Additionally, new research studies on the effectiveness of play-dough modeling and on the integration of it into post-graduate clinical training is planned.

P2-E48

Importance of anatomy and its relevance in daily clinical practice according to active Turkish physicians

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The importance of anatomy education in clinical practice is well known. Nevertheless, clinical practice changes globally and there is no international standard for anatomy education and educational methods used. In this study, we aimed to determine the importance of anatomy education from the perspective of active Turkish physicians. The findings could help to shape anatomy's place in daily medical practice and to direct future curriculum changes. Data obtained

by an on-line survey after ethical approval (number:1645, date: 29.11.2018). The demographic data of the respondents were evaluated with categorical items. For evaluating important medical topics and anatomy's role for daily clinical practice, ten-point and five-point Likert items were used. Data from 1524 respondents were analyzed. The respondents were; specialists (57.29%), general physcians (22.7%), asistants (12.07%), and academic staff (7.94%). Among active physicians, most significant topics for daily clinical practice were emergency medicine (mean:7.33), anatomy (mean:7.03), pharmacology (mean:6.86), radiology (mean:6.86), and cardiology (mean:6.84). Anatomy education was important for diagnostic/radiologic methods (mean:4.34), physical examination (mean:4.31), diagnosis (mean:4.34), and differential diagnosis (mean:4.07) for clinical practice. The importance of communication with colleagues (mean:3.94), story/symptomatology (mean:3.67) and communication with patient (3.21) steps were relatively low. Anatomy was a very important topic for Turkish physicians. It had an important place in daily clinical practice especially for diagnostic/radiologic methods and physical examination. The findings of our study may be a guide to enrich the course contents in undergraduate medical anatomy education. Focusing on radiological, cross-sectional, superficial, and interventional aspects of anatomy should be planned. In this context, a review of the National Medical Core Curriculum and integration of basic siences into it could be considered.

P2-E49

Not every grand idea in the anatomy lab works!

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Students in our institution fulfil their required anatomy lab sessions in four groups of 120, 6 students per table. An icebreaker at the start of the cadaver lab, simple and instructive, delivered to the entire group was deemed to be a good opportunity for touching on difficult concepts. The demonstration of the pelvic organs, peritoneal folds and pouches, and the larynx were chosen as pilot projects. Ethical approval not required due to information used to improve educational experience.

In the lab session for reproduction three faculty members representing and positioned as bladder, uterus and rectum, stood on chairs and were draped by a large sheet, representative of the peritoneum, forming folds and pouches.

For the neuroscience lab a cut out model of the thyroid and cricoid cartilages with thumb tags, elastic bands and tape to assemble a larynx were given to groups of students to assemble. To limit the time spent on assembling and encouragement to participate, the first group to accomplish a correct 3D model would be announced and receive a token.

As in trials when interim reports indicate a strong negative trend, our larynx model demonstration was soon scaled down to only handing out the cut out model and showing assembled ones at every table.

Post demonstration feedback from students after each lab session was useful. Loss of anonymity, being gloved for lab, too detailed were some of the received critiques. Self-observation and volunteered feedback motivated us to modify and continue developing icebreakers for the anatomy lab sessions.

Grand ideas on paper need to pass the test to validate usefulness and acceptance.

What was thought a great idea to share with the entire class needed reconsideration and may still be a great idea albeit presented to smaller groups with facilitation.

P2-E50

Advancing medical careers in The UK through the National Undergraduate Neuroanatomy Competition: An Impact Case Study

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Neurosurgery and neurology careers are notoriously competitive and require a considerable amount of portfolio development for applications to be successful. The National Undergraduate Neuroanatomy Competition (NUNC) was established in 2013 as an approach towards promoting student interest in neuroanatomy as well as giving students an opportunity for professional development. The aim of this retrospective study was to evaluate the impact attending the NUNC has on future career progression. All competitors from the 2013 and 2014 (n=79) NUNC were contacted through a combination of emails and professional internet networking sites, and invited to complete a 22 item questionnaire using SurveyMonkey. Forty two responses were received (response rate: 53.2%) of which 11 doctors were in the Foundation Programme and 24 were in Post-Foundation specialty training. Ten of these 24 (41.6%) were in a neurology or neurosurgery training program and seven of these referenced their involvement in NUNC on specialist training application forms. Nineteen (45.2%) responders either used, or will use, their involvement in NUNC as part of their applications for specialty training. Twenty-five (59.5%) of the responders would recommend NUNC as an effective way to improve the strength of job applications. This study demonstrates that a large proportion of NUNC competitors successfully enter speciality training and neurosurgery training in particular. This suggests that extra-curricular student events and competitions are a good way of proving one's commitment and aptitude towards a subject. Our longitudinal impact study will continue over further years to provide more comprehensive evidence on how the NUNC influences future medical employability.

This study was approved by the University of Southampton , Faculty of Medicine Ethics committee.

P2-E51

Troublesome knowledge and threshold concepts in the Anatomical Sciences: using curriculum mapping to support learning in a medical curriculum

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Integrated, problem- and case- based curriculum models, which require temporal and conceptual alignment of anatomical knowledge with associated topics in the curriculum, have become the norm in medical education. While these models contextualize knowledge, they may result in valuable anatomical concepts being omitted or produce misalignment between the required anatomical knowledge and linked anatomical concepts that would facilitate students' learning. Therefore, the appropriate sequencing and linking of health sciences concepts is important to ensure the effective integration of content into a curriculum. Effective integration is particularly important for threshold concepts as mastery of these concepts opens new areas of understanding in additional knowledge areas. Appropriate sequencing and linking of concepts are also important for troublesome knowledge which is defined as knowledge, skills or attitudes within a discipline that are difficult to learn or master.

Pelvic and perineal anatomy is an example of a topic that students find difficult to master. This difficult topic underpins the understanding of a substantial proportion of cases seen by women's health professionals. Effective integration of this topic and associated threshold concepts into a curriculum is vital for the students' future roles as health professionals. A curriculum map will be presented which schematically depicts threshold concepts of pelvic and perineal anatomy linked to clinical sciences, clinical skills and professional competencies, as well as teaching and learning activities that facilitate students' learning of the

concepts in an integrated manner. Curriculum mapping is a process that allows gaps and redundancies in the curriculum to be identified. Mapping also makes explicit the links between different concepts in the curriculum and associates the concepts to the teaching, learning and assessment strategies used to facilitate learning. It is hoped that this map will inspire others to design curricula that focus on threshold concepts to support student learning.

P2-E52

The role of dissection in improving anatomy knowledge in postgraduate education: a pilot study

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Dissection of human cadavers has been a prime tool in anatomical education for centuries. In recent years, the importance of dissection and its usefulness as an anatomy teaching tool has been questioned. This pilot study aimed to make a preliminary assessment of the value of dissection in knowledge of musculoskeletal anatomy at different cognitive levels. Eighteen medical doctors enrolled in a one-year postgraduate Diploma in Anatomy course at Macquarie participated in a study which was ethically approved by the University's Human Research Ethics Committee. The course comprised several on-line based modules and a research project conducted throughout the academic year, concluding with a 3-week intensive whole-body dissection module. In this study, participants were tested during the last module after they completed dissection of the upper limb, but before they started dissecting the lower limb. A previously validated multiple-choice question paper was used. It comprised ten upper and ten lower limb questions, each set of questions consisted of five lower cognitive (remember/understand) and five higher cognitive (apply/analyse) order questions of equal, high difficulty. The results for the upper limb showed a significant difference (P-value<0.0001) between low and high order questions with low order having a better average (4.3) compared to high order (2.6). The low order scores for upper limb were also significantly (P-value = 0.0001) better than the low order scores for lower limb (2.9). There were no differences between lower limb, low or high order (2.63) results. The results suggest the importance of dissection in learning anatomy, particularly at low cognitive ability. It would be expected that changes in ability to answer high order cognitive questions would be greater influenced by applied case-based learning as opposed to dissection. In future, similar studies will be carried out on a bigger sample of participants and including all body regions.

P2-E53

Evaluation of dentistry students' perceptions about implementing virtual reality in undergraduate histology education

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Over the last decade, along with technology revolution, the worldwide trend in transitioning from conventional light microscopy (CLM) to virtual microscopy (VM) in the undergraduate histology education rapidly increased. The opportunity to simultaneously deliver study materials to the students and economical benefits of VM over CLM, both have been shown as major benefits of VM implementation. Our study objective was to evaluate students' perceptions towards the concept of VM implementation as a new additional pedagogical tool during the practical portion of undergraduate histology education. Sixty-seven first year dentistry students were enrolled in the study. In

order to enable students to achieve more thorough knowledge in the practical setting and facilitate in-house studying and exam preparation, academic staff promoted free online web-based virtual laboratories as an adjunct tool to the CLM. Students' perceptions about VM implementation were then evaluated through a self developed pre-validated questionnaire using a 5-point Likert scale. The data was further statistically analyzed. 80% of students think that VM will improve the quality of practical classes. Based on their exam outcome, there were no significant differences in the answers of students considering questions supporting VM implementation. Regardless of what was the reported in-house usage of VM, there was no difference in the practical exam outcome between students. However, significantly higher percentage (53.1%) of students with negative outcome in practical examination support complete CLM elimination compared to students with positive outcome (29%), ($\chi 2=6.933$; df=2; p=0.03). Notably, 77% of students pointed out that their preference towards VM vs. CLM would truly depend on examination modality (VM or CLM). Dentistry students are keen on integrating VM, as an additional teaching tool in the practical setting of histology course. Students' exam outcome should be taken into consideration when evaluating their preferences in order to construct effective study course concept.

P2-E54

Game the Brain! The iterative, multidisciplinary development of a mobile neuroanatomy game that is both fun and educational

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Neuroanatomy remains one of the more complex disciplines in anatomical sciences education. It requires both a deep understanding of 3D anatomical relationships within the brain and a translation of that knowledge to 2D slices through the brain. An additional challenge for learners is to understand the anatomy of the main ascending and descending tracts through the brainstem as well as the location of the crossing to the contralateral side for these pathways. Mastery of neuroanatomy requires both a conceptual understanding and practice in identifying structures with confidence on slices through the brainstem and the forebrain.

The gamification of learning is a concept that aims to harness the fun and rewarding qualities of a game to make learning appear effortless.

In this project we put together a multidisciplinary team of content experts, game and software designers, and artists to develop a mobile compatible neuroanatomy game that is easy to use and yields learning results for students. The target audience was identified and characterized; play testing as well as UI (user interface) and UX (user experience) testing were conducted to ensure usability and interactivity. A narrative arc was developed for the game and chapters with three levels from beginner to expert were created based on the learning objectives of the neuroanatomy lab sessions. Principles of design thinking and iterative software design were applied in the creation of this game so that the final product would meet both the learning objectives of the course and the objective to keep the game fun and competitive.

The game was designed to fit into the existing learning ecosystem for neuroanatomy, which includes interactive online resources, 3D experiences, and lab sessions that are integrated with clinical sciences.

No institutional research ethics approval was required.

P2-E55

"Briefcases of Plastinated Organs" an Effective Way of Transfering Anatomical Material to Secondary and High Schools

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This work describes an innovative educational project aimed at promoting the use of pig plastinated organs as educational tools for secondary and high schools (SHS). At this level of education, the morphology and function of organs are taught as part of general sciences or biology. With regards to the anatomical study resin models, 3D printed specimens and dissection of fresh organs are commonly used.

Plastinated organs are effective teaching tools broadly used in university institutions. However, their use in SHS is still very restricted, mainly because of the lack of adequate materials for the necessities of schools' curriculum.

The transference of knowledge was based on three steps. First, defining a useful educational product for SHS; second, advertising it among the community of educators, and third, establishing an effective strategy of transference to SHS. The project is now starting the third action.

The product name "briefcase of organs" consisted of different sets of plastinated specimens strategically selected to describe the anatomy of the circulatory, respiratory, digestive, excretory, nervous or skeletal systems. Advertising of the product was carried out via web page and more effectively in an Open Day for biology and sciences SHS educators of the region of Murcia and neighborhood. A total of 45 SHS sent representatives to the Open Day and all participants (62) confirmed high interest in the project.

The strategy of transference was based on either rental or purchase of the briefcases.

One month after the Open Day, the education authorities of both Murcia and Valencia regions have already requested the renting of 15 briefcases each. This material will be shared among some pre-selected SHS in the oncoming 2019-20 academic year.

This innovative project demonstrates the potential of plastinates as effective educational tools for SHS.

No ethical approval was required for this study.

P2-E56

Developing Prosection-based Teaching Strategies in our Anatomy Curriculum

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Dissections and prosection are part of the anatomy curriculum at the University of Helsinki. This semester, because of the small number of cadavers, we relied more on the prosections. One group of the students participated in all of the dissections, while the second group of students participated only in the labs on the prosected cadavers. We conducted the present study in order to assess students' (1) opinions on learning anatomy by dissecting or studying the prosected cadavers (2) views on the teachers role in the labs, and (3) views on the computer based learning as an alternative method.

The first-year medical students filled out a questionnaire at the end of the anatomy course. 31 out of 60 students in the dissection–group, and 49 out of ~90 students in the prosection-group completed the questionnaire (response rates 52% and 54 % respectively). While students participating in dissections felt that learning by doing is important, they also felt that reflecting in the lab was as important. The students in the prosection-group thought that the prosections are a better way of learning anatomy than the dissections. They also indicated that cadaver-based teaching was helpful for understanding the big picture, but not so important for memorizing details. Students in both groups agreed with the statement that dissections/ prosections are a better way of learning anatomy than computer based learning. Regarding teaching strategies, students in the prosection-group preferred more teaching and more instructions and tasks rather than time for independent reflection.

In conclusion, not all the students need dissections, and adoption of more prosection-based teaching is possible, especially when activating teaching methods are integrated. The prosections were considered especially useful for understanding 'the big picture'. Computer based resources have clearly not replaced students'

perceptions about the importance of cadaver-based learning.
Ethical approval was not required.

P2-E57

Incorporation of pre-recorded instructional microanatomy videos into practical classes ahead of changes to the medical curriculum

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Over recent years the Centre for Biomedical Sciences Education (CBMSE) has created a bank of instructional videos. These cover many topics such as regional gross anatomy, physiological measurement as well as demonstrating basic laboratory techniques, with such videos incorporated into 'flipped classrooms.' Students appear to work more independently and are less inclined to ask very basic questions. Some students reported that they would like access to histology videos, similar to the gross anatomy videos that they already use. However, this type of video does not currently exist for microanatomy teaching.
With the advent of a new curriculum being introduced to Queen's University Belfast in 2020, and in line with incumbent progress testing and the introduction of the National Licencing Examination, the approach to gross anatomy and histology teaching within CBMSE will change.
Recently, the University invested heavily in upgrading of audio-visual equipment in the gross anatomy laboratories. Part of this refurbishment was the integration of state-of-the-art specialised cameras and computers linked to Mediasite. The use of Mediasite to record lectures and demonstrations within dissection laboratories has proved very beneficial to both staff and students.
This pilot study aims to make use of current learning technologies available with Queen's University, namely Philips Tutor and Mediasite. The creation of a bank of microanatomy video resources can be used to further prepare students for these new assessment strategies and professional examinations. The use of microanatomy videos in a 'flipped practical' setting can allow the academic lead to ensure that all students are provided with the same consistent level of teaching, thus preparing them to answer questions and engage in discussions on the topic at hand.
As this pilot study is considered part of the normal review of teaching material within CBMSE, no ethical approval was required.

P2-E58

New interactive learning tools can successfully transfer the learning of histology (and anatomy) to an online learning environment

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The teaching of anatomy and histology is expensive particularly in some universities with limited access to cadavers, or aging resources such as microscopes and inadequate histological slide collections. Increasing numbers of students has often required duplications of laboratory classes. Laboratory classes are staff intensive and so teaching hours are increased.
Technology can now solve these issues and also caters for the self-directed and independent learning needs of students.
Over the past several years we have successfully developed, and evaluated, innovative resources for teaching histology, including, Interactive, visually engaging, extensive, online lectures. An interactive online histology atlas. Annotated histological sections viewed using virtual microscopy. Unique strategies to engage students to view histological sections. Assessment activities.
Now, students can study histology curricula completely online – including completing extensive laboratory practical requirements. Extremely positive student feedback and enhanced learning evidence was independently quantified.

Histology students' engagement to maximize their learning outcomes was promoted by their access to both technology-enhanced and interactive learning strategies that are now available on a global scale and enabled students to complete all learning outcomes online. A similar approach has been used the past 2 years to teach a "Musculoskeletal anatomy" course.
No ethical approval was required by the "Ethics Committee" of the University of Western Australia for this study.

P2-E59

Students' Perception of Positive Effects of Small Group Learning Method in Studying Histology

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In order to enhance active learning, creative thinking and developing certain skills, the method of small group learning in socially cohesive groups was introduced during practical sessions of histology. The aim of this study was to identify students' perception of the usefulness (in general) as well as of certain advantages of the learning process and gaining self-confidence. The study is based on an online survey where students practicing small group learning for the first time, were asked to give opinion (by stating degree of agreement) on 13 statements concerning certain advantages of this method. About half of the students expressed a strongly positive opinion in the survey. They find this method of collaborative learning favorable for: enhancement of the learning process, rational organization of time, conclusion drawing, learning how to apply knowledge in practice, rising motivation, better knowing each other and experiencing a new feeling of responsibility for the success of the group as whole. However, the percentage of students who feel free to post questions, elaborate on and give explanation to statements, peer-teach and take part in discussions was not higher from the percentage when traditional teaching method was practiced. This finding highlights the need of further working on improvement the methodology of listening, answering, explaining and summarizing, for promoting students' participation in questioning, answering and statement elaborating. We find the overall findings encouraging and motivating for our dedicated work with small group learning. This project has gotten ethical approval from the Committee for ethical research with humans. The survey which is part of the project was performed with the understanding and consent of the students.

P2-E60

Introducing anatomical and clinical terminology to Medical students: A Gamified induction

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The Peninsula Medical School Anatomy team recently carried out a qualitative study to better understand our students' perception of barriers and enablers to learning Anatomy. One emergent theme was students' struggle to make sense of the new anatomical and clinical language, leading to rote learning. The meaning of terms can often be taken for granted by educators but addressing the issue can provide students with an approach to break down seemingly complicated words to better understand them.
A gamified clinical and anatomical terminology activity was piloted for Medical students during induction week. The introduction outlined why the activity is useful to them, encouraging engagement; provided the activity instructions; explained the goal of the session, to be able to 'translate' complex clinical and anatomical phrases. Cards containing an anatomical or clinical prefix, root or suffix on one side, and a definition on the other, were placed definition-side down. In groups, students identifying the terms they knew and try to work out the terms they are unfamiliar with. Staff help groups identify the more esoteric terms. This activity also

helps them identify the value of shared knowledge and group work. At the end of the session students then were able to translate the phrases provided.
Afterwards, we provided access to a short podcast about clinical and anatomical language (http://www.ifaa.net/galen/). Students' learning was assessed a week later during their Anatomage Table induction, where they were repeatedly asked to break down the names of structures. All students could identify the prefixes, suffixes and roots and apply them to what they were dissecting, suggesting the activity provided them with the required tools.
Feedback from this session was overwhelmingly positive and we have trialled it with other learner groups including experience days for school children and for postgraduate Physician Associate students, all with similar success.

P2-E61

The use of human tissue as a way to enhance classroom learning: an inter-university collaboration.

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The use of human anatomical specimens helps students to visualise the relationship of structures in their location within the human body. Previous studies have shown that having an opportunity to feel, touch and compare structures enhances students' logic and problem-solving abilities needed for future practice. The aim of this project was to expose the dispensing optician first-year students to anatomical specimens.
Eighty first-year students from the Cape Peninsula University of Technology (CPUT) visited the Department of Human Biology, University of Cape Town (UCT) over two years for practical demonstrations. The sessions included: watching ocular anatomy video clips, a talk by a senior anatomist, viewing of microscopic slides, demonstration of human anatomical specimens and eye dissection. A short task was created to guide students' learning for each station to ensure that they were fully engaged with the material covered and not merely observing. Students were given an opportunity to evaluate the session. No ethical approval was required. Permission to conduct a review of the project was obtained from the two institutions involved (UCT and CPUT).
Students engaged well with the material and interacted with demonstrators at each station. A total of 94% were either satisfied or very satisfied with the session, and a low 6% were dissatisfied. On follow up with the educators from CPUT, there was a marked improvement in students' academic performance after the excursions.
Inter-university collaboration is an effective way to support learning, as it gives an opportunity for students to be exposed to material that may not be available within their university.

P2-E62

Access to human cadaver material by an international researcher from an institution that does not use cadavers in their medical training

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Use of human cadaver dissections and specimens is considered an effective tool for studying the structural details of the human body for both learning and research. Access to human material is a challenge for anatomy students and educators in several academic institutions across the world. In Africa and USA, however, more than 90% of medical schools make use of cadaver dissections for their teaching, surgical workshops and research purposes. The aim of this project was to explore the effectiveness of providing access to human tissue for an international anatomy researcher from an institution that does not use cadavers in their medical training.
A researcher was allowed access to human tissue for a research study looking at the reabsorption of the cerebrospinal fluid (CSF) into the venous

system by injecting latex into the cisterna magna. The study was part of a larger project. This was performed in adults and full-term fetuses to see the traces of the latex through the lymphatic system all over the body. Several bodies were injected (n=4 adults, n= 7 full-term fetuses), and slices were made with a saw to make sections through the body. These are bodies that were kept for research and surgical workshops within the Department. No ethical approval was required as the use of human material is permitted by the National Human Act, Western Cape Government and covered under the Human Body donation project.

The researcher was satisfied with the results obtained to answer his research questions. In conclusion, providing access to human material to students in other institutions with no cadavers following the proper human ethics practice is essential for both learning and research purposes.

P2-E63

Evaluating university students' opinions on the use of personal electronic devices within small group anatomy teaching.

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In recent years, the use of personal electronic devices (PEDs) has become ubiquitous throughout Higher Education, including in the classroom setting. There have been conflicting reports detailing their impact on student's learning experience, with some studies stating they are beneficial to student engagement, others highlighting their potential for encouraging distracting multi-tasking. This study aimed to assess whether the recent introduction of PEDs into classroom based anatomy tutorials has been beneficial to students' experience of anatomy at the University of Birmingham (UoB).

Following the introduction of PEDs to anatomy tutorials, a questionnaire using a five-point Likert scale was issued to assess student opinion. Evidence was sought from medical, dental and biomaterial science students detailing their use of and the benefits of PEDs, including their opinions on distraction. 567 of the 569 students sampled consented to their opinion being used.

Most students reported frequent use of PEDs in anatomy tutorials (median=5; interquartile range (IQR)=2), primarily for cohesive note taking, group work and referencing. Positive experience was reported in preparation for, and during tutorials (both median=5; IQR=1); importantly students indicated that use of PEDs made them more proactive learners (median=4; IQR=1). Additionally, students reported that PEDs did not distract them during tutorials (median=1; IQR=1).

Overall, students considered the introduction of PEDs to be beneficial to their experience of anatomy in a classroom setting, contradicting previous literature which suggested they detract from the learning experience by distracting students.

While the presented data is limited to the opinions of current UoB students, the fact that responses were consistent between cohorts, the low IQRs and large sample size indicates that these findings are reliable. Subsequent investigations should attempt to establish whether the use of PEDs has a long-term effect on student experience and performance. Ethical approval has been sought from the Research Ethics Committee at UoB.

P2-E64

Disparity in expectation and engagement across student cohorts within anatomical education

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There is an abundance of evidence delineating clinical students' opinion of anatomy education, much of which shapes a university's pedagogical

approach to the subject. However, there remains a paucity of research on the opinions of non-clinical students undertaking the study of anatomy. We aimed to evaluate expectation and engagement of students within anatomy education and compare these trends across medical, dentistry, graduate-entry medical, biomedical and biomaterial science students.
A total of 1141 first- and second-year students, from the above programmes (767 clinical, 338 non-clinical), were surveyed using Likert-scale and free-text responses to questions on their experience of anatomy education at the University of Birmingham (UoB). 1105 surveys were analysed after removing those who did not consent to their data being used, or declare their programme of study.
While all groups had a preference for small group teaching (SGT) sessions and lectures over Anatomage and prosection-based tutorials ($p<0.0001$), non-clinical students were significantly more likely to read the suggested preparative material prior to SGTs ($p<0.0001$) than clinical students. Instead, 53.06% of clinical students (n=407) stated that they relied on websites like teachmeanatomy.info to undertake their research, compared to 5.62% of non-clinical students (n=19). The proportion that did not value peer teaching within SGTs differed between year groups; Year 1: 7% vs Year 2: 37.82%.
It is therefore evident that there is disparity in students' attitudes to anatomy education, primarily demonstrated by their preferences for preparatory resources and learning style within SGTs. We suggest academic staff's approach to anatomical education should vary accordingly and reflect the predilection of each student group. While these results are limited to the opinions of those currently studying anatomy in the UoB, the large sample size and variety of programs analysed represents a robust analysis. Ethical approval has been sought from the Research Ethics Committee at the UoB.

P2-E65

Change in the user profile that visits a Youtube channel on human anatomy

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The advent of YouTube in the latter part of the previous century marked a revolution in Anatomy teaching. Within this context the Innovative Education Unit of the University of Valencia (Spain) was granted permission for the creation of short anatomy teaching videos in Spanish to be uploaded to a YouTube channel. This afforded students a different modality of learning topographical anatomy.
The YouTube channel (https://www.Youtube.com/channel/UCu7PhRc9-RVPouKUSXh_Q1A) was created in October 2010 and 35 short videos were uploaded between October 2010 and September 2012 (active channel). These videos presented dissections and plastic model explanations to disseminate anatomy information for Spanish-speaking countries.
Analytics revealed that the channel received a total number of 1,003,421 visualizations from October 2010 to December 2018, but while inactive (from October 2012 to December 2018) the number was 884,450 (88.1%). During the active period uploaded videos were viewed in 37 countries, with 71% of the viewers being male and 29% female. 94% of the viewers were within the age range of 18 to 24 years old and 6% were between 25 and 34 years old. Regarding the content of the videos viewed, five videos on cadaveric dissections were among the ten most viewed. During the inactive period of the channel, 55% percent of the viewers were female and 45% male, and 71% of the viewers were between 18 and 24 years old while 25% were between 25 and 34 years old. The channel was viewed in 54

countries and only two dissection videos were in the top ten most viewed.
There is observed a change in the user profile of viewership of anatomy videos on Youtube: currently the viewers are predominantly female who prefer videos of plastic models and illustrations, whereas a decade ago majority viewers were male who preferred dissection videos.

P2-E66

The Protégé Effect: Enhanced Student Learning of Structural Concepts through Dissection-Based Case Presentations

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Problem-Based Structure (PBS) is a dissection project in three first-year courses at the Zucker School of Medicine. Student teams are assigned one of seven clinical cases for which they develop learning objectives, research, and create a presentation that highlights structural principles relevant to the case. All presentations include a dissection designed to enhance interaction with the specimen. Each case is presented to all students and incorporates anatomy, embryology, histology, pathology, and imaging appropriate to the case. A summative essay exam at the end of each course includes questions on all seven PBS cases.
We hypothesized that students would feel better prepared for exam questions related to their case than for those related to other groups' cases and would perform better on exam questions that pertained to their cases.
In response to a post-course survey, students felt more confident answering questions related to their assigned case (88%) than to questions related to other groups' topics (60%). Using a two-tailed t-test we compared the scores on questions related to students' presentations to the scores of students who did not present on that topic. Students performed better overall on examination questions related to their case than did students who presented on a different topic.
We also surveyed third-year students who had recently completed USMLE Step 1. Responses indicated that students felt more confident answering USMLE questions related to their previous PBS topics compared to topics assigned to other students.
Although attitudes about PBS varied, students tended to perform well on questions related to their assigned topics. This exemplifies the "protégé effect"- the notion that students learn better when they are responsible for teaching the topic to others. Limitations of this study include variation in numbers of exam questions on PBS topics and a lack of data regarding performance on specific USMLE questions.

P2-E67

An International comparison of medical and dental students' reflections on the topic of body donation in the Gross Anatomy course

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Anatomical dissections on donated bodies are practiced in several medical and dental faculties worldwide. The International Collaboration and Exchange (ICE) Program, organised by Columbia University, New York, is an international program

designed to connect students online to share their experiences in the anatomy laboratory. The goal of this study was to perform an international comparison on the topic of body donation (BD) in different countries.

In 2018, 205 students from 9 countries participated in the ICE Program. 60 groups of 3 to 4 students connected online using guided questions. For their first encounter, students interviewed each other on the topic of BD. The interview questions included whether the BD format of their country had been explained to them, how their assumptions about working with cadavers in the anatomy laboratory compared with their actual experiences, and whether imaging used in the laboratory helped them connect with their donor. Data was collected from transcripts of their responses. Faculty responses to whether the BD format had been explained and whether imaging was used in the laboratory were also collected. Responses to whether BD had been previously introduced to students were mixed for every country. Most countries refer to a donor as “silent teacher” while Taiwan refers to them as “body teacher”. During their discussion, students realised that some institutions CT scan the donors and wished to have the same system despite having anatomy and radiology integrated in their curriculum. Countries organize a commemorative service, helping students reflect on their experience but only Japan requires its students to meet the families of the donors prior to dissection, reversing the experience’s emotional load.

Countries are similar in the way their students perceive imaging. Differences exist in terminology used to refer to body donors and in the ways students are introduced to the body donors’ families.

P2-E68

Agile development of an anatomy curriculum in a new graduate-entry medicine degree

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Scottish Graduate Entry Medicine (ScotGEM) is a unique and innovative 4-year graduate-entry medical programme run jointly between the Universities of St Andrews and Dundee in partnership with University of Highlands & Islands. ScotGEM has been designed to produce inspirational, adaptable and compassionate generalist clinicians who will join the workforce and implement change across remote and rural Scotland. The programme is open to graduates from any discipline. The first cohort of 55 students arrived in 2018-19.

From Year 2 of the programme, students study for extended periods of time in remote and rural Scotland with clinical colleagues in NHS Dumfries & Galloway, Fife, Highland and Tayside. For this reason, it is necessary to deliver most anatomy teaching while students are on-site in St Andrews during Year 1, which adopts a case-based learning (CBL) approach.

This paper will discuss the opportunities and challenges of developing a new anatomy curriculum within unusual pedagogical and logistical constraints. Principal challenges include complying with an overarching CBL curriculum, identifying and condensing core knowledge into one year of contact time (60hrs over 30wks) and developing sessions that facilitate efficient learning for students with varied backgrounds. Opportunities include working with graduate learners who were more confident to give feedback and having a smaller cohort, which allowed staff to better understand student needs and concerns.

This paper will describe our process of being reactive and responsive to student feedback in the first year of a new programme. Our team adopted an ‘Agile’ approach to development, which draws on principles conceived to enable development of high-quality software in an adaptive way in response to ‘user’ feedback. Initial session plans were for a seminar followed by a team-based workshop. In-year redevelopment in response to student feedback resulted in the introduction of a flipped classroom approach, video recording and frequent formative assessment.

P2-E74

ANATOMY: What is the point of teaching it? Australian chiropractors' perceptions of the clinical relevance of anatomical sciences and their place in chiropractic curricula

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In Australia, all chiropractic education programs include human anatomy as a compulsory subject in the undergraduate curriculum. Clinicians' opinions on the relevance of anatomy to clinical practice is essential in assessing the appropriateness of anatomy training. The aim of this study was to assess the opinion of Australian registered chiropractors regarding the relevance of the anatomical sciences to their practices and their perception of the sufficiency of the anatomical content in their professional degree training. Following ethical approval for this study, a 13-question survey tool focussing on the relevance of the anatomical sciences to chiropractic professionals, was distributed to chiropractic clinicians in Australia. Following review, 129 completed surveys were analyzed for this study. The participants perceived their training in topographical anatomy, and neuroanatomy to be adequate, and highly relevant to their practice, while their training in histology and embryology were less adequate. While the perceived most valuable learning resource was the laboratory manual produced by the instructors, the use of lectures, prosections, dissections, and digital resources as teaching tools were also perceived as highly helpful.
Recent discoveries are increasing the understanding of musculoskeletal disorders and highlighting the role of genomic and even proteomic-level changes in disease. There is now a growing perception in the medical community that medical and health professional training must undergo significant reform in the next decade to remain equally relevant to patient education and scientific discourse. While topographical and neuroanatomy are highly relevant to chiropractic practice, it may be necessary for professionals to gain a conceptual understanding of histology and embryology to better understand musculoskeletal pathophysiology.

P2-E75

Prosections - Challenges and Solutions: Physical Therapy students as near-peer anatomy teachers in the dissection room

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The inclusion of dissection laboratories in the anatomy curriculum taught at Physical Therapy programmes requires the availability of a dissection room and skilled anatomy instructors. Considerable awareness of this issue exists in the medical field. However, there is limited information regarding the practice in Physical Therapy departments. Therefore, the aim of this study was twofold: a) to examine the effectiveness of a programme intended to train excellent physical therapy students to become anatomy instructors; b) to evaluate the satisfaction of physical therapy students from the instruction given by young instructors (0-3 years of experience).
Six highly-qualified students from the Department of Physical Therapy at Zefat Academic College participated in a special training programme focusing on the following skills: 1) preparation of a prosection; 2) basic principles in anatomy instruction; 3) handling feedback from an experienced anatomy instructor during a teaching session. Three questionnaires, filled in by the trainees, were used to assess the quality of the training programme. An additional questionnaire was used to evaluate student satisfaction with the dissection laboratory and the young

instructors. Ethical approval for the research was given by the College's Ethics committee. High satisfaction rates were given by the young instructors for each of the three parts of the training programme. In addition, high satisfaction rates were given by the students for both the quality of the dissection laboratory and the quality of instruction given by the young tutors. Moreover, similar grades in the final exam were obtained by groups taught by senior instructors as opposed to junior ones.
We therefore conclude that near-peer teaching in the dissection room is a viable alternative, provided the junior instructors receive close supervision and intensive coaching.

P2-E76

Introduction of open book assessments and correlation of student performance to traditional assessment methods

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Open book assessments are increasingly used as they reduce anxiety in students and have been shown to reveal deeper learning approaches and promote analysis of course material rather than regurgitation of facts. This assessment method has recently been introduced to second and final year anatomy modules at Cardiff. The tests comprise short (year 2) or long (final year) answer questions based on two research papers and form 20% of the module's mark. Before the test students are provided with research papers to critically analyse and they are permitted to bring notes and/or textbooks to the assessment. Students performed well in these open book tests with 65% (year two) and 59% (final year) average, which was similar to other assessments on the modules. Correlations between student performance in different module assessment methods (open book, spot test and essay) were calculated using Pearson's correlation coefficient. A strong or very strong correlation was observed between final year student performance across all assessment methods (essay/spot r=0.74, essay/open book r=0.81 and spot/open book r=0.67). Second year students' performance demonstrated very strong or moderate correlations across all assessment methods (essay/spot r=0.81, essay/open book r=0.47 and spot/open book r=0.50). There was generally good correlation observed between open and closed book assessments, showing their reliability. The improved correlation between open book and traditional essay or spot in final year students may, in part, be due to the acquired skills of these students compared to those of year two. Final year students are better at assimilating knowledge and have had time to develop and practice the skills needed. Future work will investigate open book performance across the School and student perception of this type of assessment to ascertain the perceived level of anxiety compared to more traditional forms of assessment.
No ethical approval was needed for this study.

P2-E78

Introduction of the use of Clinical Cases in the Teaching of Human Anatomy

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In a research conducted by Furlani (2004), university students face as motivation to be challenged and to elaborate their own productions under the guidance of teachers.The lack of
active methodologies hinders the construction of knowledge by the student. Improving the
didactic resources applied to the teaching of human anatomy tends satisfactorily to the
direction of actions, stimulates the participation of the student as an active subject in the
search for new information, promoting indispensable support in the teaching-learning process
(GUIRALDES et al. 1995). A strategy of teaching human anatomy based on critical analysis and

clinical reasoning through case study methodology is proposed in order to dissociate it from
the memoristic form, to elaborate and apply new didactic material based on the case studies
method and to verify the acceptance of the method applied to the medical students of ESA/UEA. The methodology adopted is a cross-sectional, descriptive study with a qualitative-quantitative approach, based on the introduction of clinical cases in the teaching of human
anatomy at the Universidade do Estado do Amazonas in Manaus/Amazonas. For this purpose,
a study material composed with clinical cases was elaborated and classes were held to discuss
and answer the doubts arising from it. A questionnaire applied to 70 medical students
evaluated the methods currently used and proposed. When questioned about the current
methodology, about 47% believed to be an adequate methodology, against 33% who judged it
inadequate. The majority, 67%, believe that other materials are needed. Regarding the new
teaching proposal with the use of clinical cases: 51% judged the material as good and
approximately 43% judged the material as excellent. Therefore, new teaching strategies are
necessary for the student to understand holistically the content taught, maintain interest in
studies, develop a critical consciousness on the subject and a thought focused on clinical
reasoning.

P2-E79

Design of a Blended Master's Course and Evaluation of Factors that Enhance the Blended Learning Experience of a Diverse Group of Health Professionals in an Anatomical context

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Technological advancement reshapes teaching and learning, however online teaching of anatomical sciences possesses various limitations. These include high cost, lack of time, skilled teachers, student support, motivation, engagement, social interaction, cadaver-based practical sessions, flexibility etc., which increases dropout rate for online courses. To overcome these, this study aims to reflect on design of a new blended anatomy course and evaluate factors that shape the blended learning experience of a diverse group of health professionals. Blended learning combines traditional face-to-face teaching methods with virtual learning approaches to enhance student-centred flexible learning in a structured way. John Briggs Constructive alignment (an outcomes-based approach) and Gilly Salmon's five stages (access and motivation, online socialization, information exchange, knowledge construction, practical knowledge development) E-tivities learning models were analysed and integrated to construct teaching and assessment activities which also kept the learners engaged, motivated and participating. To evaluate factors that enhanced the blended learning experience, student course evaluation questionnaires were analysed. Two new University of Aberdeen blended courses were developed in 2018 and were run in three semesters. Limitation factors were cross validated from the evaluation reports where students were highly satisfied with various factors: e.g., learning space, VLE resources, skilled teachers, cadaver-based videos, Collaborate video sessions, clinician-run sessions, online assessments, on-campus cadaver-based practicals, ultrasound session, encouragement, and student support. However, the online Discussion Board and 3D Anatomy TV was less popular. Requests to develop additional anatomy modules, indicating successful student engagement. Pre-course versus post-course assessment scores were much higher, indicating increased student academic performance, and increased online self-learning time proven to be cost effective.This research provides a theoretical foundation for blended course design which enhances the blended learning experience in a diverse group of postgraduate students with a zero-dropout rate. This study proposes a

validated framework for future blended anatomy course design at master's level.

P2-E80

Medical Students Perception Towards Anatomy Dissection: A Study From A Medical School In Nepal

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Anatomy is the most basic and important subject studied by medical and para medical students when they begin their medical carrier. The use of human cadavers for learning anatomy has been in practice since long. Studies done abroad shows that, preclinical students experience a variety of emotional reactions and mixed feelings when they encounter human cadavers for the first time in the dissection room. However, there are no such studies which describe the perception of Nepalese medical students towards anatomy dissection. Thus, this study was designed to determine the perception of preclinical medical students towards cadaver dissection in a Nepalese medical school. This was a cross-sectional Descriptive study carried out in Universal College Of Medical Sciences, Bhairahawa, Nepal enrolling 290 pre-clinical MBBS and BDS students after receiving written informed consent. Ethical approval for the study was obtained from the institutional Review Board. A separate questionnaire was designed for the study. For each question, the student were to choose one of the three possible responses: "yes", "no" or "undecided". Majority (56%) of the subjects were Female. The average age of the subjects was 19.91years (range 19-23). Fifty five percentage said they were curious while only 1% said it was boring. Significant majority of the students (93%) considered cadaver dissection as the best method in learning human anatomy. Almost 73% of the subjects opine that cadaveric dissection techniques can never be replaced with plastic models. On asking about the chances for dissection, 29% of students mentioned there was not enough chances for every individual and 40% said the time allocated was not enough. Most students found their first visit to the dissection room exciting and they think that dissection is indispensible and gives the best method for the study of human anatomy.

P2-E81

Student perception of assessment in Anatomy: Using the Evans Assessment Tool (EAT)

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Understanding student perception of assessment design (AD), assessment literacy (AL) and assessment feedback (AF), and how this compares with staff perception is essential to improve assessment and feedback practice in curriculum design. This study used the Evans' Assessment Tool (EAT) to evaluate perceptions of three different assessment types in a new final year anatomy module. Twelve students completed questionnaire at the end of the module, along with the module leader. Student AL (4.1) and AF (3.8) scores were higher for the traditional anatomy spot test than the other assessments in the module, which correlated with staff perception. The other assessments, in which students had less experience were rated lower. The lowest scoring category was 'Using formative feedback opportunities' (AF2 = 2.8) for the class test and this was followed by 'What constitutes good?' (AL1 = 3.2)' for the production of an anatomy e-resource. Although the overall AD of the module was rated highly (4.2), these results indicate the areas that require improvement and illustrates the importance of formative experience and providing examples of good practice for students in novel assessment types. The EAT tool is helpful for evaluation of assessment in module and curriculum design, highlighting areas for improvement and allowing better understanding and alignment between students and staff. In addition, it can also help to ensure that students take a more active role as

partners, driving improvement in their programme.
As an evaluation of a module ethical approval was not required, however informed consent was obtained from students who completed the evaluation for publication of anonymised data.

P2-E82

Dissecting Anatomy: exploring medical students' attitudes towards anatomy teaching

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Anatomy remains a core component of all undergraduate medicine programmes and a varying combination of teaching approaches are used to deliver these programmes. Quantitative research has demonstrated the superiority of one approach over another in terms of exam results and knowledge retention, but there has been little exploration of medical students' attitudes towards anatomy teaching. This mixed-methods study aimed to explore existing attitudes and further compare these attitudes between different medical schools and year groups.
Six focus groups were conducted with 31 participants from first, second and final year students at Brighton & Sussex Medical School (BSMS) and Hull York Medical School (HYMS). The results were analysed thematically using an interpretative phenomenological approach. The results and subsequent themes of the qualitative part were used to guide the creation of a 65-item questionnaire, consisting of five discrete sections on various areas of the anatomy curriculum and teaching approaches, employing a 5-point and 10-point Likert scale structure. The questionnaire was sent to first, second and final year medical students at BSMS and HYMS. A response rate of 16.95% was recorded (N=152). Ethical approval was granted and consent was sought from each participant.
Significant differences were found in favour of dissection in 73.33% of statements comparing dissection and prosection. There was a significant difference in 53.33% of statements about dissection and prosection between medical school cohorts, suggesting those who have learned using dissection have a greater appreciation of its wider benefits. A combination of dissection and prosection in an anatomy curriculum was favoured by many in both parts of the study.
Differences exist between the attitudes of medical students towards dissection and prosection as well as between medical schools and year groups. Further research is recommended and the inclusion of student input and feedback in an anatomy curriculum is encouraged.

P2-E83

Personality traits of medical students in relation to examination performances in gross anatomy

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Besides cognitive abilities, non-cognitive functions such as personality may be important for medical students to be successful in their studies and ultimately in the medical profession itself.
Previous studies comparing the personality traits amongst medical, psychological and business students suggest that psychology and commerce students are more 'agreeable' and 'conscientious' than the medical students. Gender differences were also recorded, female medical students having greater 'agreeableness', 'conscientiousness' and 'negative affectivity'. Furthermore, male psychology students showed less 'extraversion' and the male business students showed greater 'extraversion' and less 'negative affectivity'. We are presently investigating the

relationship between personality traits and anatomy examination performances amongst medical students. Following ethical approval from the Research Ethics Committee of the Cardiff School of Biosciences, medical students at Cardiff University whose results in formative and summative anatomy assessments were known were given BFI questionnaires to assess their personalities. The findings indicate that, regardless of personality, female medical students perform better in both formative and summative examinations than the male students and that the female students with negative affectivity performed better in the summative examinations. No other personality trait appeared to influence examination performance and we suggest that learning strategies (e.g., superficial, deep, surface and strategic learning) are probably more important in influencing examination performance than personality.

P2-E84

Attitude of sixth form students from private schools towards the clinical relevance of gross anatomy

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Students in the sixth form (AQA and WJEC boards - AS level/Year12) have limited exposure to gross anatomy. This might be due to the fact that most anatomy labs and dissection rooms within medical schools have an age restriction for these students to access them. Moreover, the emotional and psychological aspects related to mortality may also play a role in students limiting these experiences.

Until now, there have been no studies that have recorded the attitudes of sixth form private school students towards clinical relevance of gross anatomy.

Following ethical approval from the School Research Ethical committee, Cardiff University, sixth students from two private schools (who have opted for Biology as 'A' levels choices) were provided with a brief questionnaire that was designed in accordance with the principles of Thurstone and Chave (1951). The questionnaire consisted of randomly arranged 20 statements covering a variety of attitudes towards clinical relevance of gross anatomy.

Thirty-one students participated in the survey (Howell's School n=18, Cathedral School n=13). A 76% response rate was achieved. Our hypothesis was that these sixth form students will have favourable attitude towards the clinical relevance of gross anatomy. The results substantiated our hypothesis.

It is thought that previous exposure to dissection of plants and animals might have played a role in their positive attitude. Such prior exposure would have helped them to understand systemic and structural anatomy in both plant and animal kingdom. They might have applied the same basis towards the relevance of gross anatomy in clinical medicine. As both these schools teach Latin in GCSE, it is also proposed that most of these students might have undertaken Latin and they may have developed an appreciation and understanding of anatomical terminologies and its etymologies which might have contributed towards a positive attitude.

P2-E85

The Attitudes of Feeder Stream Medical Students toward the Importance of Understanding Classical Greek and Latin in the Development of an Anatomical and Medical Vocabulary

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Feeder stream students often find the anatomical and medical terminologies challenging. This might be due to the fact that 75% of terminologies are derived from classical languages such as Greek and Latin, which are rarely taught in schools as part of their curriculum. It has been well documented that a reduction in exposure to

anatomy, including time spent in the dissection room, impairs the students' knowledge and understanding of anatomical relationships. This further complicates the acquisition of the terminologies.

Until now, there have been no studies that have recorded the attitudes of feeder stream students towards the importance of understanding classical Greek and Latin during their medical training.

Following ethical approval from the School Research Ethical committee, the feeder stream students at Cardiff University were provided with a brief questionnaire that was designed in accordance with the principles of Thurstone and Chave (1951). The questionnaire consisted of randomly arranged 20 statements covering a variety of attitudes towards Greek and Latin and the importance of understanding these languages for medical education. Thirty students participated in the survey (Medical Pharmacology n=16, Medical Science n=14). A 100% response rate was achieved. Our initial hypothesis was that the feeder stream students have a positive attitude towards the importance of learning classical Greek and Latin. Contrary to our hypothesis, the feeder stream students had an unfavourable attitude towards the importance of learning these classical languages.

As the feeder stream students were in the Second Year of their degree, they had some exposure to anatomy through lectures and station based practicals during their initial year. Thus, it could be postulated that they became well-versed with anatomical and medical terminologies. It can be concluded that the feeder stream students are likely to have become accomplished in the origins of medical terminologies without formal instruction.

P2-E86

Influence of faculty organised revision sessions on anatomy assessment results

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Introductory anatomy courses present challenges for educators at many institutions, as they frequently comprise large numbers of students with dissimilar levels of preparedness, belonging to different academic programs. At Macquarie University, Introduction to Anatomy (IA) course enrols between 500 and 600 students belonging to four different faculties and programs ranging from health professions to law and archaeology. The failure rate has been quite high, with two practical tests (mid and end of semester) being particularly challenging. Several strategies have been employed to improve students' performance. In 2018, a week before each practical test, revision sessions were introduced, with optional attendance. These four-hour sessions were amalgams of classical teaching carried out by tutors and peer assisted learning (PAL) sessions conducted by PAL leaders. This study aimed to assess the value of revision sessions by comparing test results of students who attended and those who did not. A total of 598 students were enrolled in IA in 2018, of which 162 (27.1%) attended revision session 1 and 177 (29.6%) session 2. The average mark for practical test 1 for students who attended revision sessions was 78.8% and 74.6% in test 2, while those who did not attend achieved 61.8% and 54.5% respectively. Differences in marks for both tests was statistically significant ($p < 0.05$). It could be argued that because participation in revision sessions was optional, those who attended were motivated, high-achieving students who would perform better irrespectively. However, students that attended only one session, had test results significantly higher in the corresponding test only. ($p<0.05$). As there were no other changes in course delivery it can be hypothesised that revision sessions contributed towards better practical test performance in 2018. These findings appear to corroborate previous research suggesting that systematic and focused revision sessions improve results in anatomy assessments.

P2-E87

Augmented Reality based Support Systems for Visitors of Medical Specimen Museums

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Anatomical specimens in medical specimen museums are commonly used by medical, nursing, and paramedical students. They enable students to deepen their knowledge of the complex relationships between organs and other structures, and provide valuable experience in learning basic concepts in the field of medicine. Visitors, particularly beginners, may find it difficult to identify parts of organs without additional explanations from a docent or supplemental illustrations. Recently, many systems using augmented reality (AR) technology have been developed for exhibition facilities to increase visitor interest in exhibits. We propose AR-based support systems for tours in medical specimen museums. In this study, three AR-based support systems were developed, and their usability and effectiveness for learning were examined. The first system was constructed using an AR marker. When visitors capture the AR marker using their tablet camera, the system displays related information about the exhibits on the screen of the tablet. The second system was developed to set the specimen image itself as a marker because most specimens are cross-sectional. Visitors can obtain AR information related to each exhibit without being aware of the marker. Finally, the third system incorporates a natural click interface into a head-mounted display. The user can thereby obtain virtual information with a click gesture. The AR systems were evaluated in terms of their educational value. Research ethics of all surveys in the present study was approved by the Research Ethics Committee of Faculty of Medicine, University of Yamanashi. Eighty-four young students in medical, nursing, and paramedical courses were recruited for the evaluation. The results indicated that AR systems are supported more favorably than the traditional style of exhibit description, and may lead to improved learning achievement. The present study contributes not only to raising learning motivation for students but also to renovation of exhibition descriptions in traditional specimen museums.

P2-E88

How good are Wikipedia anatomy articles?

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Wikipedia has increasingly become a popular resource in medical education. Wikipedia is used by 90% of medical students, and was ranked number one by 56% of medical students for their most preferred anatomy resource online. However, Wikipedia has received a considerable criticism regarding the quality of its entries. Despite its popularity in medical education, no prior study has been conducted to evaluate the quality of anatomy articles on Wikipedia. In this study, forty sampled Wikipedia anatomy articles were evaluated qualitatively by three anatomists and quantitatively using computerized tools. The modified DISCERN scoring system revealed that 13 (32.5%), 24 (60%), and 3 (7.5%) articles were rated as “good”, “moderate”, and “poor”, respectively. Strengths of the sampled articles were noted including completeness and coverage (in 11 articles), good anatomical details (in 10 articles), and good clinical details (in five articles). Weaknesses reported by expert participants include missing information (in 28 articles), inaccuracies (in 10 articles), and lack or poor use of images (in 12 articles). Wikipedia anatomy articles were well updated and well supported by reliable references such as journal articles and textbooks. According to the reliability indices,

sampled Wikipedia anatomy articles were difficult to read, and more appealing to advanced readers. To sum up, our findings suggest that Wikipedia anatomy articles are appropriate to a certain extent as learning materials. It is however important for educators to bear in mind that Wikipedia content is written to suit general readers rather than medical students or health care professionals. Critical use of Wikipedia anatomy articles as learning material is therefore recommended, and should be used only as a supplementary resource.

P2-E89

The virtual spot test: Use of "pinned" virtual 3D images of prosections for assessment

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Photogrammetry software creates a 3D virtual image from many overlapping images of a physical object. In this poster we describe how accurate 3D virtual images of prosections may be created quickly and easily using inexpensive photogrammetry software (Agisoft Metashape, £420). The resulting images can be "pinned" in 3D space using inbuilt Microsoft 10 tools (3D Painter) and viewed using free software (Open3DMod). We also detail how questions created using these models compared to 2D and physical prosection-based questions in a spot test setting.
Five models were created (pelvic ligaments, two views of sectioned heads, a posterior mediastinum dissection and a gluteal region), each from 90-110 overlapping images in approximately 80 minutes. A spot test of 15 questions was prepared, each question was presented in 3 modalities: a pinned physical prosection, a 2D image of the pinned prosection and a pinned virtual 3D image of the same prosection. Students from a class of 40 second year Human Biology students were randomly assigned these questions. Informed consent was obtained from each student. This pilot study was considered part of the normal review of teaching material, and as such no ethical approval was required.Student performance on these questions was compared by modality and their evaluative feedback was gathered for each model. We found that question modality had no significant difference on student performance, student's enjoyed the use of the model and perceived the models as highly accurate and easy to manipulate. They preferred their use to the 2D format but not to the physical prosection format.
These virtual specimens may help overcome challenges of scale, formaldehyde-sensitivity, question station duplication and resource scarcity in the setting of an anatomy spot test.

P2-E92

Constructed vs Selected response in assessing anatomy Knowledge: Outcomes of student performances and gender difference

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Background: Anatomy teaching in medical school has changed considerably, yet, assessing students' knowledge has not changed despite the awareness of Bloom's taxonomy. For economical reason, we rely on selected response (SR)-MCQ that tests knowledge but not critical thinking. Contrarily, constructed response (CR) testing demands knowledge construction and higher level of thinking but more time consuming to score. Additionally, studies compare cognitive abilities of male and female students from elementary through high school employing various test constructs reported presence of gender-related differences having to do with the mode of assessment. The purpose of the study was 1. to examine the influence of CR and SR on student performance and 2. Is there a gender difference in the performances of medical students. We employed two types of test constructs viz., CR and SR exams that use the same question stem.
Materials and Methods: Each CR and SR question used the same question stem to assure all

questions were matched. Study participants were incoming first year medical students enrolled in a six-week summer anatomy course prior to the start of the school year. Group 1 included 16 students (8 male and 8 female) and Group 2 19 students (7 male and 12 female). The course focused on study of the thorax and abdomen and the student performances were analyzed.

Results and Discussions: In the midterm exam, CR exam score was lower compared to SR score. However, in the final exam student score in CR exam improved considerably compared to midterm score. Scores and statistical analysis showed comparable performance between male and female students.

Conclusions: Gender poses no limitation to medical student performance, irrespective of the type of exam format. It is possible to adopt CR exam as a formative evaluation tool for students to identify their deficits and strategize effective learning.

P2-E93

The use of iPad and ExamSoft in conducting anatomy practical examination: A dependable approach to validity and reliability of examination

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At Cooper Medical School of Rowan University, anatomy is taught in an integrated organ system based curriculum. The first-year medical students in their last 8 weeks completed the skin, muscle and skeleton module. In the second year, the remainder of the organ systems is studied. Each practical exam includes cadaver oriented 'tag' test, bones and anatomical models. Most of the questions include higher order secondary and third order questions. As the class size has increased and with a limited number of faculty, manual grading of the practical exam had become onerous. Furthermore, manual grading challenged the validity and reliability of the assessment instrument. Therefore, migration to an automated testing system was made. This move has proven to increase the validity, made the grading process more efficient and students are able to receive their practical exam scores faster with greater qualitative feedback than previous years. Recognizing the deficiency, the authors of the abstract met and operationalized the innovative system and purchased the required number of iPads through the Office of Medical Education. Student and faculty development using a mock exam was conducted. On the day of the practical exam, unique exam specific password was distributed to each student prior to the start of the practical. In addition, instructions were given on how to navigate, submit answers, and close out of the exam. IT personnel were on-hand to solve technical problems. This poster will describe the step-by-step process of the approach, as well as present student and faculty perceptions. This study was supported by the Office of Medical Education and Department of Biomedical Sciences. This study required no ethical approval.

P2-E94

The Development of an IFAA Musculoskeletal Anatomy Core Syllabus for Medical Student Education

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The study of human musculoskeletal anatomy is essential for safe and effective clinical practice as a medical doctor. However, this topic often receives insufficient programme time during medical school and perceptions differ regarding which knowledge is core. Given the lack of syllabuses specific to musculoskeletal anatomy,

the aim of this study was to provide a detailed syllabus for the musculoskeletal anatomy of the vertebral column and limbs relevant to medical students. This musculoskeletal syllabus contributes to the International Federation of Associations of Anatomists (IFAA) core anatomy syllabuses project that outlines internationally recognised standards.

Institutional ethics approval was received. A Delphi panel composed of 20 anatomists and clinicians completed an online survey to rate 2260 anatomical structures and concepts as "essential", "important", "acceptable" or "not required" core knowledge for a competent medical student. Using the percentage of panellist agreement for an item to be considered "essential", each item was classified as core (≥60%), recommended (30%-59%), not recommended (20%-29%) or not core (<20%). An additional classification component was created for items not classified as core or recommended but rated important by >50% of the panel. Any items that met these criteria were demarcated for 'future consideration'.

The number of musculoskeletal concept items categorised as core or recommended was 252/389. For the vertebral column, upper limb and lower limb the number of core or recommended items were 220/438, 322/663 and 318/770, respectively. A total of 96 items were recommended for future consideration.

The results of this first stage of the IFAA-commissioned hybrid Delphi process to generate a musculoskeletal anatomy syllabus for the vertebral column and limbs will be published on the IFAA website for international consideration and deliberation by relevant stakeholders. The intention is to set an internationally recognized syllabus, that covers the minimum musculoskeletal content relevant to medical student pre-registration training.

P2-E95

An International Partnership of 12 Anatomy Departments Leads to Successful Internationalization of Medical Student Education Via the Clinical Anatomy Course

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We present the results of an international educational collaboration between 12 Anatomy departments on 4 continents (Australia, Austria, Canada, Denmark, Finland, Germany (2), Japan (2), Taiwan, the UK, and the USA) that aims to prepare preclinical medical and dental students for future healthcare leadership roles, by providing them with skills in Public Health awareness, cultural competency, the chance to reflect on the topic of body donation, early networking opportunities, and basic sciences experiences. The international partnerships were built through connections made via the American Association of Anatomy, the Anatomical Society, and their meetings. 205 students (n=189 medical, n=16 dental) worked in small groups (n=2-4) for one semester, covering topics such as differences in their Anatomy courses, international aspects of body donation, international healthcare education and delivery, Public Health, health ethics, and health law. Students worked on a collaborative paper (choosing a subject from one of the above topics), created a video presentation, and presented their work at international virtual student conferences. Subsequently, they traveled to the partner countries to perform basic sciences research. Questionnaires submitted after their travel were analyzed, and are now being presented.

All students were inspired to learn about the culture and medical system of the partner

countries, and they felt it helped them obtain a global understanding of medicine. Students who traveled felt more empathic, more tolerant of others, and became more appreciative of what they have at home. The students wished that the program would continue into the clinical years, and desired to remain in contact with their peers. Anatomy courses worldwide can contribute to the internationalization of medical education, promote international networking, build cultural awareness, and foster international collaboration – thus, Anatomy as an educational subject field can reach beyond traditional Anatomy teaching, and contribute significantly to the future of global healthcare and medicine.

P2-E96

Sketchfab: A educational asset for learning anatomy

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The use of digital 3D models to aid learning in anatomy education has become common place over the last decade. Sketchfab is web-based platform where virtual 3D models can be uploaded, edited and downloaded. It also allows models to be viewed in virtual reality (VR) and linked to virtual learning environments. The aim of this study was to collect opinions from students on Sketchfab 3D models using a web-browser and in virtual reality (VR), and to gain feedback on the additional features of the models (annotations, voiceover and animations) to inform model development. Eighteen participants (14 female) were recruited and were asked to view seven anatomical Sketchfab models through a web-browser (WB) and virtual reality. The models varied in anatomical region with some including additional features (annotations, voiceover and animations). An online questionnaire of Likert-style and free-text questions was then completed. Ethical approval for this study was granted by the University of Dundee research ethics committee. The majority of participants enjoyed viewing WB models slightly less than in VR. WB and VR models were considered equally useful as study aids by participants (94.4%). The participants (88.9%) found the models easy to navigate, with the VR loading quicker than WB models. Annotations and voiceovers on the models were well received and a useful addition to the associated models. Physical discomfort was experienced when viewing models, this was increased in VR with some participants (16.7%) feeling motion sickness. Voice-over pacing was an issue for participants as it requires them to follow instructions. Overall, the majority of participants (94.4%) preferred viewing the models in VR rather than on a web-browser. Sketchfab offers a platform to upload and edit 3D virtual anatomy models which can be utilised in a number of ways to enhance the learning experience of students.

P2-E96

High Brachial Artery Bifurcation and Brachial Plexus Variations: A Need for Standard Terminology

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Inconsistent terminology exists to accurately characterize rare variants of the brachial artery and brachial plexus. Often published in case reports, branching variations described in the axillary-brachial arterial complex rarely include delineating features for the origin, course, and termination of these vessels. Additionally, concomitant variations of the brachial plexus are not often discussed. The purpose of this study was to characterize a high arterial bifurcation in the left axilla, and a single-corded brachial plexus variation on the right side of an 86-year-old Asian female donor-cadaver found during a routine student dissection. Cadavers were obtained legally for healthcare education from a Body Donation Program. Relevant articles were searched in MEDLINE (PubMed), Google Scholar, and manual searches of references and textbooks. Data were aggregated and assessed for characteristic comparisons, nomenclature,

origin, course, branching patterns, laterality, reported prevalence, and demographics. Most often, in relationship to the presentation that was found in this case, the high axillary arterial bifurcation has a reported 4-9% prevalence as the superficial brachial artery and a common trunk of the axillary artery – whereas, the deep brachial, subscapular and both circumflex humeral arteries arise. The superficial brachial artery is described as having an anteromedial relationship and course as it parallels the median nerve in the brachium. Another unique variation, in this case, was the presentation of a unilateral, single-corded brachial plexus, the reported prevalence being 0.8%. The terminal branches of the brachial plexus were unaffected; however, the anterior and posterior divisions of the upper, lower, and middle trunk combined into one shared cord. The presence of these variations is important to discuss for challenges to diagnostic imaging, potential mononeuropathy of the median nerve, susceptibility to iatrogenic injury in surgical interventions, and anesthetic blocks. Further research is needed to standardize the terminology used for these variations.
No ethical approval was required.

P2-E97

Should we continue to teach laryngotomies as being safe and easy to complete?

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Medical students palpate the cricothyroid membrane on each other to establish where to perform a laryngotomy in emergencies. In the cadaver lab this procedure is usually demonstrated, and students are now fully expected to be prepared to perform a laryngotomy if the need arises. Are they? This procedure was tested among thirty volunteers, medical students in their last term of basic sciences, and physicians.
Three techniques were considered based on what may be available to use in an emergency setting. Specifically, the steak knife (restaurants where a foreign object airway obstruction may occur); key ring laryngotomy device (acute airway closure in allergic reactions); and scalpel (hospital setting). Participants received a steak knife (ten subjects), laryngeal key ring (ten subjects) or scalpel (ten subjects) to complete the laryngotomy in a simulated emergency setting. Successful completion of the procedure is based on knowledge obtained during the basic sciences in medical school. IRB approval was received for this study.
In medical literature, emphasis is usually placed on this procedure since it allows quick, direct access to the larynx which is easily palpable, lacks major structures overlying it, and is therefore considered safe for individuals to perform. However, analysis of the thirty laryngotomies performed on donor bodies resulted in five lacerating an artery (cricothyroid) and fourteen lacerating a large vein (anterior laryngeal). Additionally, four volunteers did not successfully penetrate the cricothyroid membrane and seven penetrated the tracheal cartilages. This justifies the need to formally educate medical students on how to sufficiently perform a laryngotomy prior to clinical practice.
Should we continue demonstrating to medical students that cricothyroidotomies are a safe, easy procedure in the emergent setting? Or should we specify the likelihood of hemorrhage and/or false sense of simplicity in completing a laryngotomy?

P2-E98

Strategies for Management of Color Vision Deficiency in an Educational Setting

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Color Vision Deficiency (CVD) affects an estimated 8% of the Caucasian male population and a smaller percentage of women. In both instances, these individuals are often unaware of their status. A review of current literature suggests that screening incoming medical students for CVD is atypical. Considering the wide array of colorful resources, textbooks, and lecture notes utilized

throughout medical school and beyond, students uninformed of their condition may go through their education at a slight disadvantage. By bringing awareness to those creating medical school resources, limitations have the potential to be alleviated.

Throughout the basic science years in medical school, there are a number of high yield topics that require the use of color to convey information: anatomy, histology, and biochemistry to name a few. Within these disciplines, many lecture slides and educational materials contain color-coded charts, graphs, and flow diagrams. Beyond medical school, certain specialties, such as the American Association of Pathologists, require color vision screening for residency and physician positions. Knowledge of existing Color Vision Deficiency early in students' careers will allow them to excel in the basic science years and make informed decisions when choosing a specialty to pursue. Enabling students with awareness of potential hindrances as well as providing the faculty with guidelines to recognize and change troublesome materials allows for cooperative effectiveness in conveying high yield information.

We recommend implementing a screening technique for all incoming medical students, which would allow for awareness of CVD and an opportunity to devise coping mechanisms early on in their career. Concurrently, a one-page flyer of CVD friendly recommendations and examples based on existing resources will be distributed to guide faculty and administrators in creating educational materials.

P2-E99

First Patient Encounter: an introduction to dissection for medical students

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Cadaveric dissection forms a vital part of anatomy teaching for pre-clinical medical students at University College London. Dissection sessions are often the students' first exposure to death and cadavers. In order to reduce the stress surrounding dissections and to introduce students to the anatomy laboratory, we designed a 'First Patient Encounter' (FPE) session using feedback from a student focus group. This involved students meeting their dissection group and discussing their views surrounding death. These sessions were facilitated by senior medical students or 'Near-peer Students' (NPS).

Questionnaires were distributed amongst the students directly after the session and three months later. These questionnaires were designed to elicit student concerns about dissection and assess the effectiveness of the session.

312 responses were collected from the first questionnaire and 167 from the second. They showed that more than a quarter of students experienced symptoms of anxiety before the session and 22% used depersonalisation as a coping strategy. A quarter of students reported concerns about seeing the cadaver for the first time and over half expressed concerns over seeing the cadaver's face.

The questionnaire showed significant improvement in student concerns post-session ($p<0.01$). 85% reported that the session was a good introduction to anatomy teaching and working with cadavers. 74% felt their learning was aided by the NPS demonstrator.

In summary, this study shows that medical students experience distress when approaching dissection and that an introductory session effectively mitigates some of their concerns. This supports the inclusion of such a session into the medical school curriculum.

This project formed part of the UCL ChangeMakers Initiative – involving collaboration between the anatomy laboratory, medical school and current medical students. Ethical approval was obtained through adherence to the UCL Arena Centre for Research-based Education, alongside approval by the UCL Medical School and the Anatomy department.

P2-E100

Learning the biomedical sciences - motivational determinants and differences in first and second year medical students

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Several studies have investigated the motivations that underlie career choice in medical students. However, the motivations to learn the biomedical sciences in preclinical medical students are not well understood. As different components of motivation can determine students' learning behaviour, it is envisaged that knowledge about these factors can be used to foster a more effective learning process in medical undergraduates. We aimed to conduct a pilot study to characterise the differences in components of motivation between first and second year medical students at the University of Malta.

This study was a cross-sectional questionnaire-based investigation that utilised the validated Glynn Science Motivation Questionnaire II to evaluate the components of learning motivation to study the biomedical sciences in a cohort of 128 preclinical medical students. Participation in the study was completely voluntary, anonymous and consistent with the procedures of the University Research ethics board.

The response rate for this study was 45%. The coefficient of reliability for our dataset as measured by Cronbach's alpha was 0.907. Second year students scored significantly higher in intrinsic motivation, self-efficacy, self-determination and career motivation but not in grade motivation, when compared to first-year students. Factor analysis showed that self-determination and grade motivation were the most effective learning motivation factors in the entire cohort.

Our results identified significant differences in the overall motivational profile between first and second year medical students. This exploratory study presents an opportunity for further research in this field in the local student population, and its findings should be useful to instructors and policy makers to further enhance medical curricula. Given the evolving nature of the medical profession and the increasing importance of internationalisation and competitiveness, it essential that the medical education process is continually revised to feature students' motivation in its delivery.

P2-E101

Etiology of Pseudoconclusion: Phenomenon of Pseudoreplication in Human Anatomical Research

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Statistics are used to describe and quantify data and to draw larger conclusions using inferential methods. There are strict guidelines and assumptions required by statistical tests when collecting and organizing data. The samples must be independent, and the treatments must be applied randomly. Pseudoreplication occurs when the samples used are not independent, but treated as though they are. Pseudoreplication can introduce both type I and II errors into the conclusions. The field of anatomical research is especially prone to pseudoreplication due to the very nature of the human body having bilateral symmetry with two versions of many different structures. The purpose of this study is to discuss how pseudoreplication affects data in anatomical research and ways to avoid it. In this study an extensive literature review was performed, reviewing various anatomy journals to isolate possible pseudoreplication in research papers. Pseudoreplication was present in a number of isolated studies. In the field of clinical anatomy, the results of the research could have far-reaching effects. Healthcare providers often rely on study results and the possible significance to infer the findings on a population. In order to maintain efficient use of resources and integrity

of the research, pseudoreplication must be addressed in all studies. Though pseudoreplication is detrimental to the results of a study, it can be easily avoided with proper statistical analysis. This can be accomplished through more rigorous statistical training and a better understanding of test assumptions. No ethical approvals were required for our research.

P2-E102

Cadavers' dissection in the Departments of Anatomy in Greece. The body donation programs vs the unclaimed cadavers

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Background: Cadavers' dissection plays a fundamental role in teaching anatomy. Although body donation (BD) provides a certain number of cadavers, it still remains low. The current study highlights the lack of cadavers and investigates the causative agents of this shortage over time in Greece.
Materials and Methods: Our Databases were investigated for the distribution of corpses throughout the time period 1934-2019 in the National and Kapodistrian University of Athens and the Aristotle University of Thessaloniki. The number of collected unclaimed cadavers and these after BD were recorded in relation to the subjects' gender, age, place of origin and cause of death.
Results: In total 3.907 cadavers were dissected during the last 85 years, 3340 (2225 male and 1115 female) cadavers in Athens and 567 (433 male and 137 female) cadavers in Thessaloniki. Two hundred and fifty corpses derived from Athens, 2070 from the province, 600 from abroad and 420 were of unknown origin. Among them, 270 cadavers were younger than 20 years, 1220 (21-40 years), 756 (41-60 years), 880 over 61 years and 214 corpses were unclaimed. Among them, 3160 cadavers derived from hospitals, 401 from charitably institutions, 130 from their residence, 122 from psychiatric hospitals and 31 cadavers from prisons. During the period 1981-2019, 247 (129 male and 118 female) corpses were donated. Among them, 542 corpses were unclaimed and 21 cadavers derived through the BD program. During the period 1934-1959, tuberculosis was the first cause of death, contrariwise to the last decades, where cancer and cardiovascular disease took the first place.
Conclusion: The need for cadavers remains timeless because human body is an irreplaceable educational anatomy tool.

P2-E103

Educational effect of bingo in Anatomy class

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Anatomy is a knowledge about structure and function of human body. However, with the vast amount of content, many students have difficulties and burdens about anatomy. The purpose of this study was to investigate the effect of bingo to improve understanding and learning effect of anatomy subjects. This study was carried out in September, 2018, at 53 medical students. After conducting the bingo, the students were asked about the usefulness, grade reflection, concern, continuation, necessity, appropriate time and interest of bingo. And the relationship between bingo results and grades was also investigated. A total of seven bingo games were played with an average of 3.6 bingo (0-11). There was a positive response to the usefulness (3.74 ± 0.92), interest (3.94 ± 0.82), continuation (3.55 ± 1.10), necessity (3.51 ± 1.01), and concern (3.72 ± 1.01) of bingo. However, the appropriateness of the time was neutral (3.26 ± 1.02), and there were negative opinions about grade reflection of bingo (1.40 ± 0.86). The grade of anatomy subject showed a positive correlation with the results of

the bingo, but did not reach statistical significance (r = 207, p = 0.088). In addition to anatomy, histology, microbiology, and pharmacology were also considered to be useful educational methods for bingo. Bingo may be useful in medical school curriculum, especially in Anatomy. However, it has not been performed so far. More research is needed to improve learning efficiency through bingo.
No ethical approval was required.

P2-E104

Practising surface anatomy and clinical examination skills on simulated patient during Anatomy Tutorials for Year-1 MBBS Students

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New teaching methods are constantly in demand to further the learning experience. Innovative learning aids can be utilized along with traditional teaching methods to create an interactive and engaging experience. We used student volunteers as simulated patients [SP] to allow students to practise surface anatomy on SPs, learn clinical skills, apply & reinforce content learnt in classroom in a medical setting.
Year-1 MBBS students (n=120) from the National University of Singapore – Yong Loo Lin School of Medicine were enrolled in this study. Teaching sessions were conducted in 3 stages: (i) Musculoskeletal Anatomy taught at start of academic year, (ii) Trunk region and (iii) Head & Neck Anatomy taught towards end of year-1. There were 6-7 tutorials for each system, tutorial size was 18-24 students & each tutorial session was 2 hours. A survey was conducted at the end of each system using a 5-point Likert scale to assess the usefulness of SPs in imparting Clinical Examination Skills. Student participation was voluntary, permission obtained from Institution Review Board.
Results showed that 89.5% of the students in the Musculoskeletal system, 75% from the Trunk sessions and 79.5% from Head & Neck sessions found that the use of SPs helped them practice their knowledge of surface anatomy on a live subject. Additionally, students reported that they were able to retain and apply the anatomy knowledge while performing clinical examination on a patient. Response rate was 83%, 89%, & 94% for Musculo-Skeletal, Trunk, and Head-Neck Region respectively, which gave an overall response rate of 88%.
Overall, majority of students found using SPs during tutorials reinforced learning of surface anatomy and also perceived it to be applicable to an actual clinical setting. Surveys indicate that content was engaging, educational and clinically relevant; and tutorials with SPs helped them develop clinical reasoning skills. In conclusion, small group teaching sessions using SPs was found to be useful to medical students in learning clinically relevant anatomy.

P2-TE1

Comparing the Effect of Co-culture on Tendon and Bone Cells in Two Novel 3D Systems

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The interaction of bone and tendon cells in foetal life has been reported as the trigger of enthesis formation. Enthesis is a highly specialised anatomical structure that smoothly transfer mechanical forces from musculoskeletal soft tissues to bones. However, upon injury, the microanatomy of this structure is lost, which is not restored by reconstruction surgeries. Therefore, a common complication of reconstruction surgeries of enthesis tear is re-injury. Accordingly, evaluating the use of 3D models to investigate cell interactions at the enthesis would help understand its natural development and healing process, eventually helping establish new treatment options.

Two novel 3D systems were used to study the effect of 3D co-culture of bone and tendon cells in-vitro, spheroid-based and hydrogel-based models. Spheroids of tendon and bone were generated by using cell repellent, U-bottomed 96-well plates. The effect of tendon and bone spheroids co-culture showed a decrease in spheroid size and ECM formation compared to the summation of separately cultured tendon and bone spheroids. However, cell density was not significantly affected by co-culture suggesting that the decrease in spheroids size was due to a decrease in ECM formation rather than cell density. Moreover, different levels of cell-cell contact in the co-culture where bone and tendon cells were co-cultured with minimum or maximum contact between them did not show a significant difference in the results of spheroid size, cell density, and ECM formation.

Use of hydrogel-encapsulation method to produce a 3D co-culture of bone and tendon was achieved by encapsulating the cells separately in fibrin hydrogel. Novel half-well plugs were used to culture the tendon and bone cell-encapsulated fibrin hydrogels side-by-side in one culture well. The summation of separately cultured tendon and bone cell-encapsulated hydrogels were compared to the co-culture of them, which showed no significant effect of co-culture on ECM formation.

P2-TE2

Design and Development of a Novel 3D Model to Investigate Cell-cell Interaction at Musculoskeletal Interfaces

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The enthesis is a specialised structure that smoothly transfers mechanical forces from musculoskeletal system soft tissues to bones. It consists of four transitional layers: fibrous tissue, fibrocartilage, mineralised fibrocartilage, and bone tissue. The distribution of various cells and extracellular matrix is highly relevant to the enthesis function. However, this unique arrangement could be lost due to injury to the enthesis by sports, automobiles, and falls accidents. Current surgical management results in the loss of the normal anatomical structure of enthesis and its function, which is replaced by a weak scar tissue that is prone to re-injury. Moreover, natural development and healing process of enthesis are poorly understood and therefore, a 3D model of enthesis is needed for research.

A reproduceable novel 3D co-culture system of tendon and bone cells was designed and developed. This system allowed tendon and bone cells to have an artificial 3D interface between the two distinct cell populations. The method is scaffold-dependent, which utilises hydrogels as a cell-encapsulation medium for fibroblasts and osteoblasts. This system allowed manipulation of the gels to be cultured side-by-side, creating a 3D interface between the two cell types. However, to study the effect of co-culture, a suitable hydrogel must be chosen. The study investigated methods to assess candidate hydrogels suitability for cell integration by evaluating cell attachment, cell viability, and structure integrity of a cell-encapsulated hydrogel. The investigated hydrogels were natural biodegradable polymers including agarose, gellan, fibrin, and collagen. As fibroblasts and osteoblasts are anchorage-dependent, cell attachment to hydrogel was evaluated. Fibrin and collagen hydrogels supported cell attachment compared to agarose and gellan. However, cell viability in fibrin hydrogel was significantly higher than collagen. Moreover, hydrogel structure integrity was qualitatively better in fibrin compared the other hydrogels. This resulted in the use of fibrin hydrogel for an artificial 3D co-culture construct.

P2-TE3

Treatment of Adult male Wistar Albino Rat Testes with Spermatogenic-Lineage Differentiated Human Adipose Tissue Mesenchymal Stem Cells

Reverses Damage from Cyclophosphamide Injection

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We evaluated the therapeutic potential of differentiated adipose-tissue mesenchymal stem cells (AT-MSCs) for treatment of the adverse effects induced in rat testis by the anticancer drug cyclophosphamide. We assigned 27 adult male Wistar albino rats to three groups. The control group received no treatment, the cyclophosphamide group received intraperitoneal injections of cyclophosphamide at 50 mg/kg/day for 15 consecutive days, and the AT-MSC group received cyclophosphamide and a 1 ml intratesticular injection containing 1 × 106 spermatogenic-lineage differentiated human AT-MSCs. The experimental procedures were performed following the guidelines of the Laboratory
Animal Care and Use Regulations and approved by the Research Ethics Committee of the
Faculty of Medicine for Girls, Al-Azhar University, Egypt. At the end of the experiment, the rats were killed by deep inhalation anesthesia. Testicular weight and volume, levels of testosterone and follicle-stimulating hormone (FSH), and sperm counts, motility and DNA concentrations were analyzed. Histological and immunohistochemical staining of the testes was performed to identify changes in testicular structure, cell proliferation, and numbers of apoptotic cells. Positive immunostaining was determined for proliferating cell nuclear antigen (PCNA) and apoptosis regulator Bcl-2 (Bcl-2). Compared with the control group, the cyclophosphamide-treated group had significantly lower bodyweight, testicular weight and volume, sperm count and motility, testosterone level and DNA concentration, and higher FSH level, as well as markedly affected testis structure, with lower mean area percent of staining for PCNA and Bcl-2. In the AT-MSC group, levels of these variables were similar to or better than those in the control group, with significantly higher testicular volume, sperm motility and DNA concentration. These results demonstrate the benefits of using AT-MSCs to ameliorate adverse effects induced in testes by cyclophosphamide, suggesting that AT-MSCs may be useful for future regenerative medicine and clinical applications.

P2-TE4

The biomechanics study and morphology study - two way to knowledges of functions of dura mater

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In basal research study the biomechanic quality into correlation with 3 D histology study of dura mater, the microscopic study of anatomy cribriforme plate. The study of physiology described the dura mater (protection, liquorodynamic, hemodynamic, imunology, electrophysiology),
This penetrating together two specialities produce study about dura mater and physiological and pathophysiological study about function of dura mater, specially on skull base – protection and resorbtion function, function hemo- a liquorodynamical, imunological.
The biomechanical study during tensile test indicate to inner structure of material using thermodynamic theory for modelling system.
The dura on convexity is the strongest and the most stiff, firm cover of brain, to the skull base way comes to this thin, is finner-grained, less strong and less stiff. On convextiy there is dura 2time strong, less elastic then on skull base. The different quality are into coronary and sagitally plane in convexity and anterior skull base fossa. Sagitally is dury stronger, less elastic, less drawable on convexity and anterior skull base fossa. The comparison of 3D histology findings and biomechanic characteristics of dura are very narrow related and correlated.
The dura mater on skull base form the barrier intracranial and extracranial parts, which is thresholdly strong and form protection for crossway structures (vessels and nerves) through

skull base with special arrangement surround their, to preserve separation intracranial space from surround. The dura has functional points (hemodynamic, thermodynamic, liquorodynamic, imnunological, electromagnetic continnuum), but mechanical point of brain protection too.

P2-TE5

Matrix regulation of osteoclast activity - a new approach to designing biomaterials for metabolic bone diseased defects

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A balance between osteoblast mediated bone formation and osteoclast mediated bone resorption is integral to maintaining healthy bone. However, excessive osteoclast formation and resorption can lead to metabolic bone diseases, including osteoporosis, associated with substantial mortality, morbidity, and huge health care cost. We hypothesise that osteoclastic activity can be regulated by biophysical and biochemical cues of the extracellular matrix (ECM), and understanding these cues will enable the development of orthopaedic biomaterials structurally designed to impede pathological osteoclast activity.
Utilising porous scaffolds, the specific aim of this study was to investigate the effect of ECM stiffness and composition on osteoclast progenitor-cell activity.
Collagen-hydroxyapatite (CHA) and collagen-glycosaminoglycan (CG) scaffolds were cross-linked using two different methods - 1-Ethyl-3-[3-dimethylaminopropyl] carbodiimide hydrochloride (EDAC) and Dehydrothermal (DHT) - to produce a range of scaffolds with varying composition and stiffness. The scaffolds were cultured with RAW 264.7 pre-osteoclast cells and analysed using PicoGreen® dsDNA quantitation assay to determine the effect of stiffness and composition on cell proliferation. Haematoxylin and eosin staining was used to investigate cell migration within the scaffolds.
Increasing stiffness did not affect cell attachment or proliferation in CG scaffolds, however, increasing stiffness in CHA scaffolds significantly increased cell proliferation. Interestingly, although CG scaffolds are less stiff than CHA scaffolds, the overall percentage proliferation of cells over the culture period was higher in CG scaffolds. Histologically, it was observed that CG scaffolds impeded cell migration into the scaffold matrix compared to CHA scaffolds.
These results indicate that composition has a significant effect on osteoclast-progenitor cell behaviour, independent of stiffness. Furthermore, the migration pattern observed in the CG scaffolds suggest that the increase in cell proliferation is limited to the periphery of the scaffold and that this composition deters the infiltration of the cells into the scaffold, protecting it from osteoclast induced resorption.

P2-TE6

Morphometry of human gum stem cells irradiated with infrared laser AsGa

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Mesenchymal stem cells (MSCs) are used in bioengineering to repair or replace organs. The objective of this work is to determine the morphometry of normal and irradiated MSCs with As Ga laser which were obtained from the gum of donated humans according to protocols approved by the Scientific Ethics Committee of the Universities of Los Andes and La Frontera of the Republic of Chile. Cells were characterized in vitro by flow cytometry and multilineage tri-differentiation; subsequently they were irradiated with AsGa laser (λ 904nm, 100mW). Once (time 1) at 0 hr and twice (time 2) at 0 and 48hrs. They were organized into: Group 1: control without irradiation; Group 2: irradiated at 1 J /cm2, for 1s; Group 3: irradiated at 6 J / cm2, for 1.4s. The MSCs were treated with standard histological techniques for their dimensional analysis. They were photographed in an optical microscope and

the images were processed for morphometric analysis (area, diameter and perimeter) with ImagePro Plus v6 software. Statistically IBM SPSS Statistics v25 software is used.

It was found that there are significant differences in their dimensions between the control group and the irradiated groups with 1 Joule / cm2 and 6 Joule / cm2 ($p < 0.05$). But there were no significant differences in the dimensions between irradiated cells.

Keywords: MSCs - morphometry- laser AsGa.
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P2-TE8

Anatomical design of a tissue engineered in vitro model of the human flexor digitorum profundus enthesis

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Anatomical design of soft-hard interface tissue engineered models is critical to realise their clinical application of implantation in damaged native regions, however this is rarely appreciated. The insertion of flexor digitorum profundus (FDP) onto the distal phalanx is a commonly injured enthesis, and we have applied human morphometric data to construct an in vitro model specific to this area.

Fresh-frozen human cadaveric fingers from body donations to The University of Edinburgh Medical School, under the Human Tissue (Scotland) Act 2006, were dissected to isolate the FDP insertion. 47 fingers were assessed for size and shape morphometrics of the insertion footprint after methylene blue inking and tendon excision. Mid-sagittal sections of a further 47 entheses underwent wax histology processing to analyse tendon fibre angle at the soft-hard tissue interface (tidemark). Tendon width at 0-12mm distances from the FDP insertion was measured in 64 fingers. All measurements were performed on digital images using Image J software.

The FDP footprint was trapezoidal, and for all fingers combined, the means (±SEM) of footprint measurements were 5.45mm (±0.21mm) (height), 8.58mm (±0.37mm) (base width), and 1.60mm (±0.11mm) (apex width); tendon width at 12mm proximal to insertion was 4.69mm (±0.20mm) and tidemark fibre angle was 30.08° (±0.64°). Based on these results, we enhanced a basic 35mm well in vitro model consisting of a brushite bone block attached to a tendon analogue formed from a contracted cell-seeded fibrin gel. Footprint measurements guided bone block fabrication through reverse molding, and tendon width was directed by length of a tendon-anchoring suture, 12mm from the bone block. Bone-tendon interface angle was manufactured through a 30° culture shelf, using Tinkercad software designed molds for angled bone block placement whilst retaining a horizontally cultured tendon analogue. This study integrates anatomy into engineering design and highlights the anatomist's role in the tissue engineering team.

P2-TE9

A Hydrogel Scaffold Derived from Decellularized Porcine Liver Extracellular Matrix

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One of the most crucial problems of the generally used two-dimensional (2D) cell culture method is that it does not accurately depict the three-dimensional biological environment. To solve this problem, it is essential to fabricate three-dimensional (3D) cell culture techniques which not only support long term stable culture of cells but also maintain greater cellular activity of the cultured cells than do 2D cell culture techniques. In the present study, a composite hydrogel containing decellularized PLE-1-1 and MF-1-1 was constructed for use in 3D culture of thymic epithelial cells (TEC). The cytotoxicity and cell proliferation was evaluated by WST-1 assay. The

efficiency of spheroid formation was assessed by phase contrast microscopy and confocal microscopy. The gene expressions associated with activity of TECs was examined by RT-PCR. It was found that the PLE-1-1 and MF-1-1 composite hydrogels not only facilitated the proliferation and spheroid formation of TECs, but also stimulated the expression of genes involved in TEC activity compared to the PLE-1-1 alone or MF-1-1 alone hydrogel. Thus, these results suggest that PLE-1-1 and MF-1-1 composite hydrogel will be a useful model of 3D cell culture for TECs and may have wide applicability for 3D culture of various cell types.

P2-TE10

Modelling the Development of Human Tissues In Vitro Using Mammalian Stem Cells and Advanced Cell Technologies

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Human tissue development is a complex process which occurs within the developing embryo, resulting in the progression from a totipotent zygote to the complex tissues found in the human body. This is a process that remains poorly understood; current studies utilise pluripotent stem cells (PSCs) to model events which take place. Specifically, embryoid body (EB) formation is used, as these multicellular structures are highly controllable and show self-organisation, recapitulating some events of early embryogenesis. Increasing EB size leads to viability and structure issues with an increasing diffusion distance limiting oxygen/nutrient diffusion. This prevents long term EB studies, yet time is crucial to the developmental process. The teratoma assay is also used to study complex cellular differentiation: putative PSCs are xenografted into an immunodeficient mouse host, forming a tumour. The detection of structures from three germ layers is indicative of pluripotency, yet assay variation brings into question its 'gold standard' status. In this study, we have used a polystyrene scaffold in combination with advanced culture methods to improve cellular viability, therefore enabling long term in vitro culture. Initial studies extended EB viability through seeding onto the scaffold, showing that the resultant tissue discs produce morphologically recognisable mature tissue structures derived from each germ layer. Use of the scaffold in a novel perfusion system shows cells can be maintained in vitro for time periods comparable to the teratoma assay to significantly enhance the maturation of the teratoma-equivalent formed. Recent work has focussed on directing the differentiation of EBs towards specific germ layers as well as using human PSC populations to fully validate the model. This model has potential to be used to study early tissue development, as well as providing an in vitro animal free alternative to the teratoma assay.
Animal studies were completed according to Home Office guidelines.

P2-TE11

Regeneration of upper urinary tract using mESCs derived ureteric buds

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Kidney disease and its related complications are an important public health problem worldwide. Pluripotent stem cell (PSC)-derived kidney organoids are a new advance in the field of regenerative medicine, which may facilitate drug testing, disease modelling and generating tissue for renal regeneration or replacement. There is intense interest in turning organoids into complete kidneys for transplant. Less explored is the idea of transplanting organoids into diseased kidneys, to replace damaged tissue. This approach would depend on an ability of organoid collecting ducts to join those of the existing

kidney. To test whether PSC-derived ureteric bud/ collecting ducts can connect with existing collecting duct trees, we have differentiated HoxB7-GFP mESCs into ureteric bud (iUB) using the Taguchi methos and grafted them adjacent to the ureter or the collecting duct system of cultured E11.5 mouse kidneys. The iUBs grafted in the metanephric mesenchyme showed branching and nephron formation, and they apparently fused with the host mouse collecting duct system. Those grafted by the ureter fused with it and expressed uroplakin, a marker specific for urothelium, and acquired a smooth muscle coat. We regard this experiment as a first step towards integrating organoids with host kidney tissue.
No ethical approval is required.

P2-V1

Microscopic Features of the Rat Thymus and Spleen Under the Impact of Xenobiotics

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Pollution of the environment and its influence on the body is a very urgent problem for medicine.
The experiment was conducted on 24 WAG male matured rats with the initial weight 180-220g. Animals were randomly divided into 4 groups 6 in each depending on the length of administration: 7, 15, 30, 45 days. A widely used polyether – tryglycidyl ether of polyoxypropylentriol (TEPPT) was chosen. All rats were treated via gastric gavage during 7, 15, 30, 45 days by aqueous solutions of TEPPT in dose 1/10LD50 in conversion to 5.75g/kg. Rodents were deduced from the experiment by immediate cervical dislocation, experimental protocols were approved by the institution's ethical committee. Obtained material was fixed in 10% neutral buffered formalin for 24 hours, were subjected to standard processing and embedded in paraffin. From the prepared blocks made serial sections thick 5x10-6m stained by Haemotoxylin eosin. Histological examination was performed with microscope «OlympusBX41» followed by morphometric study using «Olympus DP-soft 3.12» program. Statistical comparison was performed using Mann-Whitney test for statistical analysis.
Analyzed data demonstrate reliable changes during all stages of the experiment, where the spleen red pulp area increased by 36.26%, diameter of lymphatic follicles decreased by 16.96%, width of the mantle zone by 19.06%, width of the marginal zone by 8.65%, while width of periarterial zone increased by 10.69%. In thymus the changes in the ratio of the cortical substance by 48.13%, of the medulla - 30.34% and stroma - 8.6% were observed with the maximal alterations on the 45th day of the experiment.
The identified structural changes in the thymus indicate the reaction of the immune system organs, which some authors associate with an increase in the frequency of apoptosis and a decrease in the level of cell proliferation in response to adverse factors.

P2-V2

Evolution and Morphology of the Tetrapod Brachial Plexus

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The brachial plexus is formed by interconnected spinal nerves that give rise to branches which innervate the muscles associated with the pectoral limb. Historically, the utility of this anatomical structure has largely been associated with practical medical and veterinary interests, although recently the utility of the plexus in understanding mammalian evolution has been explored. In this study, we examine published and novel dissections of the brachial plexus across a broad range of tetrapod taxa for common traits using character optimization, sometimes known as trait mapping. Each of the major clades of tetrapods is included in the analysis, as are major clades of mammals following from published records. Our results indicate that the overall dorso-ventral patterning of the brachial plexus is a highly conserved trait, while other features seem to characterize large clades. Autapomorphies are common throughout

the plexus, which is also known to exhibit substantial polymorphism. The traits that characterize large clades may be indicative of developmental or functional constraints on brachial plexus morphology. No ethical approval was required for this study.

P2-V3

The Terminal Ventricle in Saguinus Leucopus

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The terminal ventricle of the central nervous system is located at the medullary cone and is and expansion of the central canal, associated with the cerebrospinal fluid. It is covered by ciliated ependymal cells, which is evident in some primate species including the human. There are very few studies in non-human primates and none in Saguinus leucopus, therefore the main objective of this study was to identify the terminal ventricle in this endemic primate of Colombia.

We used three male specimens were obtained from an ethical source, having died by natural causes in wildlife care centres of -CORPOCALDAS- (Colombia). These specimens were fixed using subcutaneous, intramuscular and intracavities routes with a solution of 10% formaldehyde, 5% mineral oil and 1% phenic acid. The epaxial muscles of the lumbar and sacral regions were separated to extract the spinal cords. These later were sectioned in sagittal planes for histological processing by haematoxylin eosin staining.

We find that the terminal ventricle was present in the spinal cord of S. leucopus as an expansion of the ventricular system at the level of the medullary cone, continuing with the central canal in its most cranial part and at its caudal end, therefore this ventricle is not the final part of the ventricular system in this species. It had an average width of 275.52 micrometers at its widest part and was covered by ciliated ependymal cells, which reflects a common phylogenetic characteristic of primates as a neuroanatomical pattern.

P2-V4

Morphology of the tongue of the White-cheeked Gibbon (Nomascus leucogenys) and Pileated Gibbon (Hylobates pileatus) Hylobatidae, Primate - comparative study

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The white-cheeked gibbon (Nomascus leucogenys) and the pileated gibbon (Hylobates pileatus) are primates, which are currently placed on the IUCN Red List of Threatened Species that are considered critically endangered and endangered. Both species are predominantly frugivorous, although they may also consume leaves and insects. We studied the tongues from one adult male white-cheeked gibbon and one newborn female pileated gibbon. According to the Polish and European law, studies on tissues obtained post-mortem do not require an approval of the Ethics Committee. Histological studies were carried out on samples stained with hematoxylin&eosin, Masson-Goldner trichrome and azan trichrome. The tongue of the Nomascus leucogenys was 6 cm long, while that of the Hylobates pileatus was 3 cm long with rounded tip of the tongue. The dorsal surface of the apex of the tongue in the Nomascus leucogenys contained dark pigment. In both gibbons, the apex and body of the tongue was covered by filiform papillae, while the root of the tongue was covered by conical papillae. The fungiform papillae were spread between the filiform papillae and covered the apex and body of the tongue but also the lateral ventral surface of the tongue. There were four vallate papillae in the Nomascus leucogenys and eight such papillae in

the Hylobates pileatus. The histological study revealed that there were numerous taste buds in the lateral and external walls of the vallate papillae in both gibbons. Several folds formed the foliate papillae on both posterolateral sides of the tongues. The plica fimbriata was bifurcated in the Hylobates pileatus, while it was very small in the Nomascus leucogenys. The variable features of the tongues are associated with functional adaptation to the animals' diet, but also the stage of development of the specimens as another potential cause of the variations observed.

P2-V5

Comparative study of the adrenal gland morphology in two species of wild mammals: Sulawesi bear cuscus (Ailurops ursinus) and Philippine mouse-deer (Tragulus nigricans)

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The Sulawesi bear cuscus (Ailurops ursinus) is a vulnerable marsupial from the Phalangeridae family, while the Philippine mouse-deer (Tragulus nigricans) is the smallest endangered ruminant of the Tragulidae family. The aim of this study was to carry out a comparative analysis of the morphologcial features of the adrenal glands in these two wild mammals. The adrenal glands were collected post-mortem (as result of natural death) from four adult Ailurops ursinus and nine Tragulus nigricans, which inhabited the Wrocław Zoological Garden between 2015 and 2019. The research samples were assessed macroscopically and using light microscopy (hematoxylin&eosin, Movat pentachrome and picro-Mallory trichrome staining). The left and right adrenal gland in the Tragulus nigricans was bean-shaped and was 1 cm long. The right adrenal gland of the Ailurops ursinus was heart-shaped and 1.5 cm long, while the left gland was oval and 1 cm long. The connective tissue capsule in the Tragulus nigricans was very thin (the mean thickness was 69.29±13.52 μm), while it was thicker and amounted to 288.58±46.67 μm in the Ailurops ursinus. In the Ailurops ursinus, the fibrous lamina and the cellular lamina of the connective tissue capsule contained numerous adipose cells. The cortex of the adrenal glands contained three layers: the zona glomerulosa, the zona fasciculata and the zona reticularis. The cell arrangement in these three layers differed between the Tragulus nigricans and the Ailurops ursinus. In the Ailurops ursinus, numerous adipose cells were present in all the cortical layers. The zona glomerulosa was atypical in the Tragulus nigricans, while it was thick in the Ailurops ursinus. The medullary venous plexus was present in both examined species. The description of physiological morphological features of the adrenal glands in these two species of wild mammals may be useful for future comparative studies to assess adrenal gland pathologies in these species.

P2-V6

The microstructure of the superficial gland of the third eyelid in the aardvark (Orycteropus afer Pallas, 1766)

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The aardvark (Orycteropus afer) belongs to the Tubulidentata order. We present the first data concerning the microscopical structure of the superficial gland of the third eyelid in one adult aardvark from the Wroclaw Zoological Garden (Poland). The research material was collected in 2017. The animal was not killed for the purpose of this study and the tissue samples were obtained post-mortem. Immediately after collection, the superficial gland of the third eyelid was fixed in 4% buffered formaldehyde for at least 72 hours and washed in running water for 24 hours. The study samples were dehydrated

with ethanol in a 75%, 96% and 100% solution. They were then processed in a vacuum tissue processor – ETP (RVG3, Italy), embedded in paraffin and cut using a Slide 2003 (Pfm A.g., Germany) sliding microtome into 3-4 µm sections. The samples were stained with: hematoxylin and eosin, Masson-Goldner trichrome, picro-Mallory trichrome, Movat pentachrome and the following histochemical stains: periodic acid-Schiff, alcian blue pH 2.5 and pH 1.0, alcian blue pH 2.5 /PAS and high iron diamine. The superficial gland of the third eyelid in the aardvark was multilobar tubuloacinar and was surrounded by a thick connective tissue capsule. The connective tissue divided the stroma into a few large lobes and many small lobes. The trabeculae contained numerous blood vessels. The acini containing a small lumen were composed of tall conical cells with an eosinophilic cytoplasm and were surrounded by basal myoepithelial cells. The tubules with a large lumen were composed of a single cuboidal cell layer with rounded nuclei. The histochemical studies found that the superficial gland of the third eyelid of the aardvark was serous. The obtained results suggest that the structure of the gland and its secretion is related to the functional adaptation of the aardvark to its natural habitat.

P2-V7

The histological and histochemical analysis of the superficial gland of the third eyelid and lacrimal gland in the neonate pygmy hippopotamus (Choeropsis liberiensis, Morton 1849)

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The pygmy hippopotamus (Choeropsis liberiensis or Hexaprotodon liberiensis) belongs to the Suina suborder and the Choeropsis (Hexaprotodon) genus. We present data concerning the microscopical structure of the superficial gland of the third eyelid together with the third eyelid and the lacrimal gland in the three neonate pygmy hippopotami from the Wroclaw Zoological Garden (Poland). The study samples were collected from 2016 to 2018. The animals were not killed for the purpose of this study and were obtained post-mortem. The approval of the Ethics Committee was not require. Immediately after collection, the samples were fixed in 4% buffered formaldehyde for at least 72 hours and were washed in running water for 24 hours. They were then dehydrated using ethanol in a 75%, 96% and a 100% solution. Then, they were processed in a vacuum tissue processor, embedded in paraffin and cut using a Slide 2003 (Pfm A.g., Germany) sliding microtome into 3-4 µm sections. They were then stained using the following histological and histochemical stainings: hematoxylin and eosin, picro-Mallory trichrome, Movat pentachrome (modified Russell Movat), periodic acid-Schiff, alcian blue pH 2.5 and pH 1.0, alcian blue pH 2.5 /P.A.S., and high iron diamine. The superficial gland of the third eyelid in the neonate pygmy hippopotamus had a multilobar tubuloacinar structure with a predominance of mucous acini and was surrounded by a thick connective tissue capsule. The histochemical study revealed that the gland produced a mucoserous secretion. The lacrimal gland in the neonate pygmy hippopotamus was multilobar tubuloacinar and was surrounded by a thick connective tissue capsule with numerous adipose tissue overgrowths. The histochemical study found that the lacrimal gland was serous. The results indicate that the morphological features of the superficial gland of the third eyelid and the lacrimal gland in the pygmy hippopotamus are strongly associated with its natural habitat.

P2-V8

Morphology and arrangement of dermal scales in the caecilian Ichthyophis kohtaoensis (Gymnophiona: Ichthyophiidae)

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Caecilian, an amphibian in the order Gymnophiona (Apoda), is the only group of amphibian that covers their body with dermal scales. This character is an evidence for the potential evolutionary link between fish and amphibian. The scales are usually found in dermal pocket between annuli along body length. However, size of the scale could be varied and each species tended to show different morphology and arrangement of scales. In this study, morphology and arrangement of the dermal scales were studied in the common caecilian Ichthyophis kohtaoensis found in Thailand. Specimens of I. kohtaoensis from the Herpetological Collection, Natural History Museum of Chulalongkorn University were processed through clearing and staining methods. These specimens had been previously acquired in accordance with the National Code of Ethics for Laboratory Animal Use (NRCT, 1999) and the Wild and Protected Animal Act of Thailand (1992). Upon completion, caecilian body was relatively pale, while dermal scales were specifically stained with Alizarin Red. Scales from different parts of the body including collar, trunk and tail, in the dorsal and ventral parts, as well as the left and right parts of the body were examined under a stereomicroscope. Dermal scale density, arrangement, size and morphology were recorded. The results showed that the dermal scales in the dorsal part have a higher density with more incidence of overlapping scales compared to those in the ventral part. Number of scale row and scale size increased from the collar to the tail. Dermal scales in the collar region were relatively smaller with oval shape, while the scales in the tail region were relatively larger with round shape. Common characters of these dermal scales included a fingerprint pattern on every scale. Overall, results from this study could be used as one of the evidences for clarification of caecilian systematics in the future.

P2-V9

Comparative cranial capacity: a morphometric analysis of dolphins, dogs, pigs and horses

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Morphometric analyses are vital to the anatomical description and understanding of any species. The head is the most frequently used region in morphometric analysis as it contributes to identification and validation of a species. Most studies on exotic animals have reported morphometric analyses of the head using skull samples, which often may differ from whole animal analysis. We recently had access to the CT images of whole dolphins and hence used these images to analyse the morphometry of their head and cranial cavity and compared this data with three domestic species (dog, pig and horse). For each species, ImageJ software was used to measure the cranial capacity and the area of the head. To account for the variations in the age and the size of the animals we calculated the ratio of the cranial cavity area to head area (CAHA) and have expressed this value as percent of head area. The mean CAHA ratio in the dolphins (41.78 ± 18.67 %), was significantly higher compared to the dog (20.24 ± 3.40; $p < 0.01$), the pig (4.86 ± 0.61; $p < 0.001$) and the horse (8.49 ± 0.49; $p < 0.001$). The dog had a significantly higher CAHA ratio than the pig (20.24 ± 3.40 Vs 4.86 ± 0.61; $p < 0.05$) and the horse (20.24 ± 3.40 Vs 8.49 ± 0.49; $p < 0.05$). The functional anatomical consequences of such variations should be further explored, especially in the study of animal cognition, intelligence and learning abilities.
Ethical approval was granted for this work.

P2-V10

Art as an Instruction Medium in Veterinary Anatomy

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Drawing anatomical specimens can help students develop their observational skills and reinforce the concepts of scale and proportion. In addition, the anatomical relationships of organs can be illustrated. This study examined some of the artwork used in two Veterinary Anatomy departments (Dublin and Murcia) to highlight the ways in which this approach can be used as an adjunct to traditional teaching methods.

Veterinary students in Murcia have the option of partaking in anatomical drawing classes which are taught by a skilled veterinary-qualified artist. The teacher guides the students in developing their skills in producing sketches that are anatomically accurate. A typical example of the teaching material is a detailed sketch of the dissected horse head.

Comparative anatomy underpins the study of the abdominal organs. In Dublin, students are encouraged to sketch their dissections to develop an appreciation of the size and position of organs and their inter-species differences, especially in cattle and horses, which due to their large size provide significant challenges. For example, the ruminant stomach is a large (80 litre capacity) four-chambered structure with the final compartment (the abomasum) corresponding to the glandular stomach found in other mammals.

While the non-glandular components of the bovine stomach all originate from the fundic region of the primordial stomach, these three regions differ anatomically. By its use of colour and texture, this student painting illustrates these different properties. Using acrylic paint on canvas, this artwork shows the internal anatomy of each stomach compartment (ruminal papillae; reticular honeycombs; omasal leaves and abomasal rugae). A bold colour palette was chosen to evoke intrigue for species anatomically distinct from humans. In addition, the anatomical relationships of the compartments are clear, a concept difficult to appreciate during dissection classes.

P2-V11

Hematology of the Head-starting Hawksbill Turtle, Eretmochelys imbricata, in Thailand

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The hawksbill turtle has been listed as a critically endangered species. In Thailand, hawksbill turtles nest on the confined shoreline of the Gulf of Thailand, especially at Talu Island, Prachuap Khirikan Province where the Siam Marine Rehabilitation Foundation has initiated a head-start program by collecting and incubating the eggs, and raising the turtles in captivity before releasing them into nature. In the nursery, health assessment has been carried out mainly by external examination, and alternatively by hematological assessment. The latter is a parameter known to have diurnal variation which may affect the interpretation of turtle health. In this study, we aimed to observe diurnal variation of hematological parameters in the head-starting E. imbricata. Blood samples were collected from the juvenile hawksbill turtles reared at Talu Island. Blood sampling was carried out at both day time and night time. All samples were subjected to hematological evaluation for differential leukocyte count, packed cell volume and plasma biochemical parameters including total protein, blood urea nitrogen and creatinine. In addition, environmental parameters of the nursery such as water temperature, water salinity, water pH, air temperature and light intensity were recorded. The results indicate that diurnal variations of hematological parameters was evident, especially with percentage of heterophil, percentage of lymphocyte and ratio of heterophil:lymphocyte. The results from this study are crucial for hematological interpretation and useful for the health assessment of the hawksbill turtles reared in captivity in the future. Permits to work with E. imbricata were approved by the Department of Fisheries, Ministry of Agriculture and Cooperatives, Thailand (Approval No. 11/2559) and the experimental protocol was

approved by the Animal Care and Use Committee of Faculty of Science, Chulalongkorn University (Protocol review No. 1623013).

P2-V12

Histological investigation for an incidence of testicular ovarian follicles in the male rice frog Fejervarya limnocharis (Anura: Dicroglossidae)

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Frogs have been used as sentinels for environmental health hazards since their habitat is vulnerable to pollution, and their development can be affected by xenobiotics contamination. Prior study revealed that the rice frog, Fejervarya limnocharis, living in areas with different degree of herbicide utilization showed testicular ovarian follicles (TOFs) in adult male testis. It is unclear whether the presence of TOFs is linked to a background contamination of herbicide in the area or a normal developmental process of the testis in this species. This study thus aims to examine histological structure of the testis of the rice frog living in an area with no background contamination of herbicides. Male frogs were field collected from the University Forest and Research Station in central Thailand. After euthanasia by immersion in 1% tricaine methanesulfonate, frogs were measured for body size and weight. Testes were weighed, fixed, preserved and processed through paraffin method and subjected to hematoxylin and eosin staining. Histology of testis was examined under a light microscope and an incidence of TOFs was recorded. It was found that a condition factor and a gonadosomatic index of frogs in this area are comparable to those of the healthy rice frogs living in the reference area in prior studies. Incidences of TOFs in adult, subadult and juvenile frogs ranged from 92% to 100%. As there is no evidence of herbicide or endocrine disrupting chemicals (EDCs) in this area, the high incidence of TOFs in F. limnocharis suggested that the intersex gonad may occur as a natural process of testicular development. As a result, the use of TOF as a biomarker of effect for EDCs exposure in this frog species might be invalid. This experimental protocol was approved by the Animal Care and Use Committee of Faculty of Science, Chulalongkorn University (Protocol review No. 1923001).

P2-V13

Comparative anatomy of the Saimaa (Pusa hispida saimensis) and Baltic (Pusa hispida botnica) ringed seals

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The Saimaa ringed seal is thought to have originated from the Baltic ringed seal population and it became landlocked about 9500 years ago. Previous studies have shown that the genetic differentiation between these subspecies is high, and that the Saimaa ringed seal teeth have a unique molar phenotype compared to that of the Baltic ringed seal. The aim of our research was to study the anatomy of these seals further to see if there were also soft tissue differences. Our study methods include anatomical dissection, preparation of silicone casts, as well as computed tomography and magnetic resonance imaging. We found relatively few soft tissue differences between these subspecies. Nevertheless, the tongue of the Saimaa ringed seal was more oval-shaped and the bifid apex of the tongue more rounded than those of the Baltic ringed seal. The origination point of the first segmental bronchus from the right caudal lobar bronchus differed between these subspecies, and there was some variation in the number of floating ribs but more specimens are needed to confirm this. Combined with genetic analyses, our data will improve our understanding on the evolutionary phenomics of

mammals. The main limiting factor in our study was the number and quality of the Saimaa ringed seal specimens as this subspecies is one of the most endangered seals, with roughly 400 individuals left. All Saimaa ringed seal specimens of this study were found dead, and the Baltic ringed seal specimens were legally hunted as part of the annual quota.

P2-V14

Is the Distal Accesory Ligament of the Horse Connected to the Superficial Digital Flexor Tendon?

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The accessory ligament of the deep digital flexor tendon (AL-DDFT) of the horse acts during the extension of the fetlock, protecting the muscular belly of the DDFT from overstretching and possible tearing. Recent descriptions of the AL-DDFT based on dissection, cross-sections and imaging techniques mentioned the existence of a connecting fibrous band (FB) between the AL-DDFT and the superficial digital flexor tendon (SDFT). FB could be of relevance in desmitis or other pathologies associated with lameness of the thoracic limb. Detailed anatomical description of the FB and its potential relationship with neighboring structures, such as the common synovial sheath of the flexor muscles (CSSFM), is still lacking. In this work serial thin cross-sections of the metacarpal region including the FB were microscopically studied and then used to render a 3D model.
Fifteen distal thoracic limbs were obtained from a local abattoir. After vascular injection specimens were sectioned at -80ªC to obtain serial 2mm thickness cryosections, distal to the carpometacarpal joint. Sections were plastinated with epoxy E12 protocol, scanned at high resolution, viewed under light and confocal microscopes, and processed with the Amira software for reconstruction.
The microscopical study showed that FB is made of connective fibers from the LA-DDFT and the CSSFM. The 3D model confirmed this information and showed further proximodistal morphological details of the FB. It was possible to define the topographic relationship of the FB with the metacarpal fascia and the SDFT.
A need to review clinical aspects of the LA-SDFT, such as the diagnosis of adhesions in cases of desmitis of LA-SDFT, or tendonitis of the SDFT is concluded. Also, the rethinking of the surgical protocols in case of the desmotomy of the LA-SDFT is recommended.
No ethical approval was required for this study.

P2-V15

"Cephalopods of the Mediterranean Sea" an analysis of the first scientific book, 1851 on the subject

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The cephalopods (octopods and decapods) were uncommonly scientifically described in the 19th century. A few naturalists enterprised collections and studies in this field. Owen, d'Orbigny, Férussac brought new classifications. Vérany (1800-1865) after beginnings in Nice, contributed by a scientific journey (1833) in south America, by collecting them on a Sardinian royal vessel. He pursued his studies in Genova.
A rare, original monography written by Vérany in Nice about the "cephalopods of the mediterranean sea " was published in Genova by the "Imprimerie des sourds-muets" in (1847)-1851 The exact title was in French: "Cephalopodes de la Méditerranée. Mollusques méditerranéens observés, décrits et chromolithographiés d'après le vivant."
The book was read, pictured and its plates analysed.
The book was an in quarto (in-4°) with132 pages and 43 plates. The drawings and the prints of the plates by chromolithography were the work of the author.
Jean-Baptiste Vérany (1800-1865) discovered several species of cephalopods. One of them

holds his name: Logigopsis veranyi. He numbered 44 species of which only 25 were known a few years before. The description of Vérany was very accurate with a meticulous description, noticeing their colors inside and outside the water. He performed parallels between the species, described their similitudes and differences, their natural sites and habits, as their zoological history in the litterature.
The book of Vérany on the Mediterranean cephalopods was a landmark in the field by its scientific value: description and classification. By the exquisite quality of the drawing and the colors of its plates, it was one a the most wonderful book of his time on the marine fauna.

P2-V16

Homarus gammarus (european lobster): frontal seriated CT-scan and reconstructions: horizontal, sagittal and 3D

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The european lobster (Homarus gammarus) is a large, common crustacean. The aim of the study was to analyse by CT-scan, the anatomical structures and relationships of a large marine arthropod with a solid, external structure. The Homarus gammarus was chosen to analyse by CT-scan due to its size and relative internal complexity. Material; An intact frozen lobster was CT-scanned using a Siemens somatomedin, whole body apparatus with 128 stellar detectors. The lobster was 26,5cm long and 7cm wide. Methods; The entire animal was CT-scanned all along the rostro-caudal axis, in axial (anatomically frontal) cross-sections and reconstructed in the two other planes (horizontal and para-sagittal) and in 3D. The frozen lobster was laid in a prone position on the radiological table. It was CT-scanned with an acquisition (100 kV, 18 mAs) in the axial plane, and with joined (every 0,8 mm, 1 mm) cross-sections. Two diffferent penetrations were used: B30 for the soft parts and B70 for the hard parts (cartilage and exoskeleton). Results; Five hundred frontal cross-sections were reconstructed from the native, axial acquisition. One hundred and twenty para-sagittal cross sections and eighty horizontal sections were reconstructed. Eleven 3D reconstructions were realised with several incidences and penetrations: superior, inferior, rostral, caudal, postero-superior, antero-inferior, antero-lateral and superior (right and left), lateral (right and left), median sagittal. Conclusion; The reconstructions demonstrated the structure of Homarus gammarus and their relationships. The muscular masses presented little differentiation. The rare cartilaginous structures were well vizualised. A voluminous air pouch in the rostral and dorsal part of the cephalo-thorax corresponded to the two parts of the stomach: atrial, the rostral one; and cardial, the caudal one. There was no conflict of interest in this study.

P2-V17

Anatomy of the frogs, by Gautier d'Agoty: a plate engraved by Delaguette in 1752, in Paris

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The frogs are one of the most common amphibians. They have been anatomically examined by dissection very early and were at the origin of the discovery of the capillaries by Malpighi, a few decades after the demonstration of the bood circulation by Harvey in the 17th century. The aim of the study was to precise scientifically and anatomically, a plate of frogs by the french engraver: Gautier d'Agoty, very famous for his plates in 4 (blue, red, yellow, and black) colors of human anatomy with a medical doctor: Duverney. An engraved plate of frogs of the same green species was presented with seven figures. The figures were observed, pictured and measured. The plate was 14,5cm wide and 20,5cm high. It contained two thoraco-abdominal dissected, male and female specimens; the dissection of the genito-urinary apparatus in both

sexes; one entire, living frog; and one tadpole. This plate was originally an in 4# size: later they were reproduced for some of them in 12# size. It was extracted from a periodic published by the author: "Observations about the natural history, etc..." mainly a self-promotionnal edition, in Paris (1752) by Delaguette. Jacques-Fabien Gautier d'Agoty (1716-1785), a follower of Le Blon, was very famous for his procedure of engraving in four colors. His publication of an in folio book "complete myology in colours and real sized myology" remains a master piece in human anatomy with Du Verney (1648-1730), a professor of anatomy in Paris; as a full size atlas with spectacular, obstetrical, anatomical women remaining still nowadays a plus in medical or cultural exhibitions. This plate was an early, living witness of the anatomy of the frogs which are worldwide disappearing for unelucitated reasons, since several decades. There was no conflict of interest in this study.

P2-V18

A method of anatomy of the horse for the artists with functional aspects by VINCENT and GOIFFON, 1779, in Maison Alfort

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The anatomy of the horse was studied from a long time as the main transport in ancient eras. It was only during the 18th century that the functional aspects of the locomotor apparatus in the horse became a scientific topic. Antoine VINCENT and Georges GOIFFON published in 1779, a seminal book: "memory of the relative principles for the representation of the animals", in the Royal veterinarian school of Maison-Alfort (near Paris).
The 1st (text) and 3rd (23 plates) parts of the book had been written and drawn by Antoine VINCENT, follower of Georges GOIFFON; the second part was unknown.
The two parts of this seminal book in there original edition, were read, pictured and measured.
This in folio was complete of the parts 1 and 3. It presented a detailed title, a 2 pages preface; a 20 pages' preliminary dissertation; an introduction in two parts: 1= p.21 to 51, and 2= p.52 to 148. The 23 plates (pl.) measured 39x50cm when unfolded with the figures included in 25,5x41cm frames. There were several aspects of the osteology of the horse (pl. 2 to 5), of its myology (pl. 6 to 8; 10; 20, 21), arthrology of the limbs which were dissected at different levels (pl.11, 12, 13, 14). Three plates presented the anatomy and the different types of motion in the horse with four different paces (trot and several gallops: pl.17, 18, 19) with figured hoof's pists.The equilibrium of an isolated rider on position on his (unrepresented) horse take place on the pl. 22 with three figures (front, profile, posterior). Several plates presented the results of different measurements of the axis of the limbs in different allures and upright.
This abundant work announced the further studies of Marey and Muybridge with the chronophotography.

P2-V19

Variations in the origin of the right coronary artery in ostrich hearts. (Struthio camelus)

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The ostrich belongs to a group of terrestrial birds known as ratites. Their heart irrigation has characteristics very similar to those of mammals, with arteries distributed on the cardiac surface. The presence of a single coronary artery is considered a congenital malformation that could lead to a deficit in coronary perfusion and be a cause of ischemic symptomatology.
We analyzed 100 ostrich hearts. Birds were aged between 1 year and 1 year and 3 months, with an average weight of 92 kg. For precise visualization, coronary arteries were catheterized and injected with Neoprene Latex 650 by Dupont, red for the right coronary artery, and yellow for the left

coronary artery. They were fixed in 10% formalin for 10 days.

Two (2) cases were observed where the right coronary artery originated as a collateral branch of the left coronary artery, one ran between the aorta and the pulmonary artery; the other anterior to the pulmonary trunk, replacing the coronary artery. Coronary arteries had a diameter of 6.05 mm and 2.5 mm; a 90.4 mm path was recorded reaching the right margin and diaphragmatic surface of the heart.

P2-V21

Incidence of orthopaedic conditions: A Radiographic study of Feline patients at UCD Veterinary Hospital

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Caseloads in orthopaedic practices are often dominated by dogs, with cats being underrepresented. Several studies have been done to investigate the incidence and types of orthopaedic conditions commonly seen in canine patients, but little comparable research has been done for feline patients. This study aimed to investigate this by examination of radiographs (n=180) of feline orthopaedic cases which were admitted to UCD Veterinary Hospital between January 2010 and December 2017. This consisted of both first opinion patients that received primary care (including emergency admissions) and referral cases. The caseload data were analysed and patients were categorised based on breed, age, sex, weight, the presenting complaint and the type of orthopaedic condition present (both major and incidental findings), the latter being diagnosed by an experienced radiographer. Four main condition categories were created: Degenerative conditions (16); Fractures (91); Tumours (30); Others (43). A large proportion of patients belonged to the Domestic Short Hair/Long Hair breeds, the major representatives of the local feline population. There was no significant evidence of breed predisposition to orthopaedic disease in cats. However, it was observed that trauma was an important precursor to conditions in younger animals, while older animals were more prone to degenerative diseases and conditions that occurred as a secondary consequence of a separate, primary disease.

The findings from this study may be useful to those interested in feline medicine or for use in clinical teaching institutions as part of the curriculum.

A larger sample size incorporating a greater variety of breeds would better determine the incidence and types of orthopaedic conditions occurring in feline patients. It should also be noted that the hospital population may not be representative of the general population. Ethical approval was granted for this work.

P2-V22

Vasculature anatomy as a marker for hematotoxic effect of the Russell's viper Daboia siamensis venom on chick embryo Gallus gallus domesticus

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The Russell's viper, Daboia siamensis, is one of the important venomous snakes causing serious public health problems in Southeast Asia. Its venom contains a variety of enzymes and peptides that cause hematotoxic effects. Since antivenin commonly used for treating snakebite patients may lead to a lethal allergic reaction, medicinal herbs have become an important alternative treatment for snake bites. To test for efficacy of an herbal extract against snake venom, an effective screening method is needed. Prior studies showed that chick embryos can be used as an alternative model for in vivo screenings of

herbs. In this study, microanatomy of embryonic vasculature was examined and verified as a suitable marker for hematotoxic effect of the snake venom. Gallus gallus domesticus (white leghorn) eggs were obtained at day 0 after laying, and kept in a microprocessor controlled incubator to increase the survival rate. Eggs were cracked open to transfer embryos and yolk to a plastic wrap hammock at day 2, and embryos were incubated until day 6. Venom solutions in phosphate buffered saline were added to filter papers and laid on top of vitelline veins of embryo. After 4 hours of exposure, blood vessels at the treated area were collected, fixed, processed through paraffin method, and stained with Periodic acid–Schiff. Microscopic examination for change at the basement membrane, presence of clotted blood in the vessel and loss of membrane integrity was carried out. Overall results confirm the hematotoxic effect of D. siamensis venom on chick embryonic vasculature, and provided a reference guide for testing efficacy of herbal extracts against snake hematotoxin. The results from this study could be applied to validate the potential use of chick embryo as an alternative assay in toxicological studies.

P2-V24

Skull Anatomy of Forest Skinks (Sphenomorphus Fitzinger, 1843) Living in Different Habitats of Java and Sumatra Islands, Indonesia

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Skink is one of the most diverse groups of reptile. Conversely several species have generalized external morphology. In Southeast Asia, the forest skinks in the genus Sphenomorphus are widely distributed and living in various habitats. In addition, the taxonomy of these skinks is still controversial. Java and Sumatra Islands are located in the Sunda Land biodiversity hotspot. The skinks that live in these areas are considered as having a cryptic lineage. Following herpetological surveys in montane forest of Java and Sumatra, the taxonomy of these skinks have been revised under the humane approved protocols number UTA IACUC A12.004 from the University of Texas at Arlington. Skull comparative anatomy had been conducted among various groups of the forest skinks including Sphenomorphus cameronicus, S. melanopogon, S. cyanolaemus, S. scotophilus and S. sungaicolus. Micro-computed tomography scans were obtained from these specimens by using inspeXio SMX-100CT, Shimadzu. The results indicated that there are different skull characteristics among species especially for the species that live under leaf litter. For example, S. cameronicus lives under leaf litter and has a smaller optic cavity compared to other species that live above the leaf litter. The skull of S. cameronicus is more compact and the eyes are recessed in the optic cavity, they do not project dorsally as in the other species scanned. The epipterygoid is at right angle with sagittal body plane which is different from other species having obtuse angle. Results indicate that skull comparative anatomy plays a role in the taxonomic study of skink.

P2-V26

Gross anatomy of the brachial plexus in three species of wild carnivorans (Lontra longicaudis, Procyon cancrivorus and Potos flavus)

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The order Carnivora has a high diversity of species with different kinds of locomotion, as such their thoracic limbs have different morphological

adaptations - among them neurological adaptations. Procyonids such as Potos flavus and Procyon cancrivorus have palmigrade locomotion mainly in order to move among trees, while mustelids such as Lontra longicaudis have palmigrade locomotion in order to swim. These species sometimes are present in wildlife care centres, therefore the aim of this study was to contribute specific anatomical knowledge of the brachial plexus. This will provide the anatomical basis for neurological diagnostics, surgical approaches, locoregional anesthesia and evolutionary studies. Gross dissections were made in six dead specimens donated by CORTOLIMA (environmental authority), among them four Potos flavus (two males and two females), one Procyon cancrivorus (female) and one Lontra longicaudis (male), which were fixed with formaldehyde. This study was approved by the bioethics committee of the Universidad del Tolima. The brachial plexus of the three species originated from the ventral branches of C6, C7, C8, T1 and T2. In a male Potos flavus specimen it also was contributed by C5. All origins of each nerve were reviewed, even the brachiocephalic nerve reported in the domestic dog, but this nerve did not send branches to the brachiocephalic muscle in Lontra longicaudis, as it was only directed to the adjacent skin. The communicating branch of the musculocutaneus nerve to the median nerve was observed surrounding the axillary artery, therefore it developed an Ansa axillaris in the three species, however in Lontra longicaudis this was very small. In conclusion, this study corroborated that the brachial plexus in these species can be originated from C6-T2, and in C5-T2 in some cases of Potos flavus, and that an ansa axillaris can be developed in species of the order Carnivora.

P2-V27

The anatomy of the Eurasian lynx (Lynx lynx) triceps surae muscle

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The Eurasian lynx is a small sized felid with a hunting behavior resembling that of the large pantherine cats. We have investigated the musculoskeletal anatomy of the lynx in order to understand the locomotory adaptations required for hunting large prey. One of the key muscles in this respect is the triceps surae. The triceps surae has two functionally different components; the soleus and the gastrocnemius. In many species, the soleus is mainly responsible of maintaining the posture, whereas gastrocnemius is responsible of powerful movements, such as required for a felid pouncing toward a large prey. We hypothesized that the lynx has extremely specialized triceps surae muscles.
We dissected the hind limbs of 5 Eurasian lynx. The muscles were mapped, photographed, measured and weighted. We also sampled for histology and performed antibody staining on cryostat sections in which the numbers of fibers containing fast or slow myosin heavy chains were counted and analyzed. Our results show that the size and architecture of the lynx triceps surae does not scale differently to the body mass as compared to other felids. However, the distribution of myosin types supports our hypothesis. The soleus consists exclusively of slow type fibers (Type 1), whereas 50-60 % of the fibers of gastrocnemius are fast (Type 2), with no significant differences between the lateral and medial heads of the muscle.
Our study reveals adaptations in the lynx muscle histology, not apparent in the gross anatomy.

P2-V28

Larval morphology of the freshwater crab, Esanthelphusa nani, as revealed by confocal laser scanning microscopy

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The freshwater crab is an excellent representative for studying reproductive adaptation from sea to land. However, with a unique association between larva and yolk, an imaging technique with the appropriate resolution for studying development of the freshwater crab is still limited. This study aimed to investigate a normal stage of larval development of Esanthelphusa nani, a common rice field crab found in paddy fields of northern Thailand, using confocal laser scanning microscopy. Ovigerous crabs found during March and April were collected and acclimatized in a laboratory. In each day, 20 eggs were randomly sampled from each female crab and fixed in ethanol. Eggs were initially examined and recorded for larval stage under a stereomicroscope. Afterward, fluorescent technique was applied on the eggs to observe larval morphology and identify stage of development under a confocal microscope. It was found that larval development of E. nani can be completed in eggs within 12 days. Pre-organogenesis stages characterized by a superficial cleavage include egg-cleavage, egg-blastula and egg-gastrula. Organogenesis stages identified by appendage appearances include egg-nauplius, egg-zoea and egg-megalopa. Unlike other freshwater crab, E. nani larvae hatched at megalopa stage and took a few hours to metamorphose to juveniles. The present normal developmental stage of the rice field crab larvae demonstrates the fine details for studying and comparing among crabs and provide insight into an adaptive radiation of the freshwater crab.

P3-AL1

Analysis of blunt force trauma patterns inflicted by a hammer and a tyre iron onto the cranial bones of sheep (Ovis aries)

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Trauma to bone often results in the production of a mark/pattern or 'signature' of the weapon used to inflict the trauma. This study aims to increase current understanding of whether tools used as blunt weapons produce identifiable characteristics and are therefore distinguishable from one another, and to determine whether any resultant characteristics are statistically different. This work also compares traditional visual analysis (acetate overlay analysis) with more recent and robust analysis methods (K-means cluster analysis and geometric morphometric analysis). In this blind study, two tools (hammer and tyre iron) were used to strike thirty-seven sheep heads (Ovis aries). A male 'perpetrator' struck each head once using a natural angle and velocity to replicate 'real world' blunt force trauma attacks. Each head was macerated and then examined. Nineteen of the thirty-seven sheep heads displayed skeletal trauma resulting from the strikes. To establish which tool had inflicted each wound, the marks were imaged and digitised using tps software. Visual tool-mark and k-means clustering analyses were conducted, both of which correctly identified sixteen out of twenty-one of the marks (76.2%), although the incorrect identifications were different between the two methods of analysis. Principal components analysis was performed and consensus patterns and regression visualisation plots were utilised to graphically represent differences in the mark shapes, although multivariate testing showed these to be non-significant. The results of this study support visual and k-means clustering analyses, however, they do not support the use of geometric morphometric analysis or the notion that trauma patterns are statistically distinguishable from one another.
The sheep used in this study were professionally slaughtered; there were no ethical implications.

P3-AL2

Analysis of sharp force trauma patterns inflicted by five different scissor types onto the cranial bones of sheep (Ovis aries)

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Currently, sharp force trauma is one of the most common forms of murder in the UK. The occurrence of stab wounds as a result of scissors is increasing, however, research in this area is currently limited. The aim of this study was to identify the number of wounds inflicted onto the heads of thirty sheep (Ovis aries), and the scissor types used to produce these wounds. Wounds were inflicted using five common scissor types: office, hairdressing, kitchen, nail (straight) and nail (curved). Using a different scissor type for each head, a male 'perpetrator' inflicted wounds in a downward motion. Analysis was initially conducted as a blind study; the researchers were not informed of how many wounds were inflicted and which scissor types had been responsible for producing each mark. The specimens were macerated and photographed; identification of the number marks was carried out initially from these images. An illuminating lens was then used to examine the actual specimens. Three different methods were used to analyse the shape of each mark. The first was the traditional method of tool mark analysis using acetate overlays, the second was a similar overlay method using Photoshop, and the third utilised morphometric analysis. The results showed that determining the number of stab marks was more successful when using an illuminating lens and observing the actual specimen rather than using digital images. Analysis of the shape of these marks showed that different scissor types have similar wound profiles and that the same scissor type can create a large variation of wounds, making it difficult to assign a specific scissor type to each wound. These findings suggest that caution is warranted when interpreting the morphology of scissor wounds in forensic cases.

The sheep used in this study were professionally slaughtered; there were no ethical implications.

P3-AL3

Sexual Dimorphism in the Afro-Caribbean Skull Using Linear Measurements of the Palate with Emphasis on the Incisive Canal

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Determination of sex is the first stage of identification of human remains in forensic anthropology and is an integral part of post mortem examination. Anthropological methods of identification offer a simple cost-effective, relatively reliable, and accurate form of determination of sex. When faced with remains where the soft tissue may be lost by carbonization, trauma, or advanced stages of decomposition, resulting in partial or full skeletonization, Anthropology becomes critical to the identification of the victim's sex, stature, and age in medico-legal cases.

The objective of the research was to collect baseline measurements of the palatal length and breadth in order to calculate the average palate size and maxilloalvelolar index in Afro-Caribbean skulls. Measurements were taken from palatal landmarks with emphasis on the incisive canal. Measurements of interpalatal sutures were taken to determine if sexual dimorphism was present.

Morphometric data was collected using 18 dry skulls within the Basic Medical Science, Faculty of Medical Science, the University of the West Indies. The study included 11 males and 7 females between the ages of 40 to 70, which were free of deformity, damage, and were fully ossified. The measurements were taken with digital callipers.

This study had a low sample size and had to be taken into account when analyzing the data. The size of the palate, 39.007±3.062 mm (males) and 35.192±4.197 mm (females), was the only variable found to demonstrate sexual dimorphism according to the Wilcoxon Rank Sum Test ($p < 0.05$). There was no statistically significant difference between all the other methods measured. Additional morphometric data is needed to produce an overall baseline average for the Caribbean population.

No ethical approval was needed as previous approval had been given for the use of these specimens in research by the University of the West Indies Ethics Committee.

P3-AL4

Academic body donation programs in the United States: A systematic review of disclosure statements in documents of gift

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Human anatomy is a branch of science often considered key to the education of healthcare professionals, the teachings of which has historically been accomplished by the dissection of human bodies. As such, many academic health centers located in the United States have body donation programs that function to support their institutional education and research missions. To become a body donor in the United States, an individual or their legal surrogate, typically authorizes the donation after reviewing disclosures and signing a form known legally as the "document of gift." In the United States, each state has adopted a version of the Uniform Anatomical Gift Act which governs how and who can make, amend or revoke an anatomical gift. These regulations are otherwise not prescriptive of information body donation programs must disclose to potential donors. The authors have conducted a systematic review of disclosure statements in documents of gift from 93 academic body donation programs that are publically available. Document of gift forms were reviewed for the presence or absence of 30 specific donation consent disclosures. There were notable differences in key disclosure areas within the documents of gift including: the nature of the donation (purpose of donation, costs associated with the donation); the nature of the beneficiaries of the anatomical gift (institutional affiliations, use location, nature of use); and the preparation and final disposition methods a donor's remains may undergo. In light of the lack of regulation relating to donation disclosures, the authors conclude that a great deal of variation exists among body donation programs. The authors see an opportunity to create a guidance document for body donation programs to provide robust disclosures to those interested in donation.

P3-AL5

Chronological historical overview of legislation relating to human remains for teaching and research in South Africa

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The Anatomy Act of 1832, its related amendments and the Human Tissue Act of 2004 has been spotlighted by historians, ethical and legal fraternities primarily for its role in medical education. However, in South Africa the chronological events from date of conception of the legislation governing human leading up to the National Health Act of 2003 have not been documented.

This preliminary study aims to document the background, formulation and significance of the legislation governing human in order to access its impact and role in anatomy teaching in South Africa.

In 1911 the first lecture on anatomy began and was restricted to surface anatomy and osteology at the South African College (SAC) because the then Anatomy Act had not been passed and the use of cadavers for dissection was not legally permitted. In July 1911, The Anatomy Bill was presented and passed, shortly thereafter dissections began. In the very same year, a Rhodesian prisoner's body was sent to SAC from Robben Island, recorded to be the first "convicted criminal" to be dissected. Following many amendments this bill, during the apartheid era was referred to 1983 Human Tissue Act which has been amended and replaced with the current 2003 National Health Act. Parliamentary debates

show that even in South Africa, the unclaimed, poor, black and marginalised were overwhelmingly used for dissections.

P3-CS2

Effect of possible radiography machine rotations on the radiographic measurements of tarsal Parameters in lateromedial view of the Equine tarsus

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The effect of rotations in field radiography has vital importance in diagnosis of tarsal pathologies and differentiation of any changes caused by such rotations. Radiography is an important diagnostic tool to evaluate limb deformities but is sensitive to changes in orientation of object, cassette or radiography machine. Influences of limb rotation on radiographic measurements of lateromedial tarsal radiographs have not been addressed in spite of their significant effects. This study measured effects of possible radiographic machine rotations during tarsal radiography around vertical and horizontal axes on 10 tarsal radiographic parameters and identified an acceptable range of rotation where those parameters experienced a minimum change. Fifteen hindlimbs from 12 adult equine cadavers (that died for reasons not related to this study) were transected at the distal third of the tibia, fixed vertically, and then digitally radiographed 13 times. The first radiograph was aligned to a specific set of vertical and horizontal landmarks called zero-degree lateromedial (ZLM) defined by overlapping of the lateral and medial trochlea of the talus and a contact point between dorsal edges of lateral and medial borders of the central tarsal and subsequent radiographs were rotated through -15˚ to +15˚ in both axes with 5˚ intervals. Parameters were measured on the 195 radiographs and analyzed using a paired t-test to compare each angle of rotation (-15°, -10°, -5°, +5°, +10° and +15°) with the zero angle of rotation for each parameter. This was done for both the vertical and the horizontal rotations. Most of the parameters showed significant alterations during vertical and horizontal rotations. Using rotational angles of Vertical±5° and Horizontal±5° in only one axis as the maximum acceptable range of rotation from ZLM would offer the best potential to avoid significant effects of rotation on these tarsal radiographic measurements. No ethical approval was required for this study.

P3-CS3

Relationship between mandibular foramen and inferior occlusal plane in dry mandibles and their clinical implications

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The inferior alveolar nerve block (IANB) consists of deposition of the anesthetic solution in the region where the nerve penetrates the mandibular foramen (MF). Due to being an internal structure and not clinically palpable, anatomical references like the inferior occlusal plane (IOP) are used for orientation at the time of anesthesia. This work aims to investigate the relationship between the MF and the IOP in anatomical pieces for clinical guidance of the IANB. We selected 82 dry human jaws of Brazilian adults, totally/partially dentate, accounting to 66 left and 66 right antimeres. A flat strip of rigid PVC plastic was supported and stabilized on the posterior teeth, simulating the IOP. Using a digital caliper and the IOP as reference, the perpendicular distance to the lowest point of the FM was measured, adopting negative values caudally and cranially positive. Regarding the antimeres, the majority of FM lower limits were below the IOP (rights: 86.4%, left: 81.8%), with an average of -4.2mm (± 4.8) in the right and -4.1mm

(± 4.8) in the left, without statistically significant difference. Because of the unpredictable location of MF presented here and the information available in literature, alternative anesthetic techniques would be more interesting during clinical routines, since they do not depend so much on the precise location of the foramen. The IOP does not seem to be a good reference for the location of FM and, in turn, for the orientation of the inferior alveolar nerve block in Brazilian adults, given the marked topographic variations found. Thus, when faced with failure of the IANB, the professional should use alternative anesthetic techniques that do not depend significantly on the precise location of FM, such as Gow-Gates.

P3-CS4

Retromolar foramen: frequency, morphometry and topography in human dry mandibles

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The retromolar foramen, situated in the alveolar and central part of the retromolar trigone, consists of the external opening of a canal located inside the mandible body, called the retromolar canal. Although well described in the literature, the retromolar foramen and canal are often neglected by surgeons, besides not being mentioned in dentistry books, nor in the official Anatomical Terminology. Over time, some studies have sought to evaluate occurrence, topographic and morphometric characteristics and neurovascular content of these structures, although still without complete definition. The aim of this study was to perform morphometric, topographic and frequency analyzes of retromolar foramen in human dry mandibles of adults collected at the skull museum of UNIFESP / Paulista Medical School. Two researchers evaluated two hundred and sixty-five human dry mandibles, visually and simultaneously, in the laboratory ("Skull Museum" - Federal University of São Paulo / Paulista Medical School - São Paulo, SP, Brazil) without gender or ethnic classification. With the aid of metal wires, each retromolar foramen was classified by diameter. Forames less than 0.5 mm were not counted in this study. The study was submitted to the Brazil Platform and approved by the Research Ethics Committee under the number 62066216.4.0000.5505. RESULTS: Retromolar foramen were observed in 23.4% of the cases, with a higher incidence unilaterally being 12% of the present cases, compared to 10.6% of the bilateral cases found, and may occur in number of up to 4 in the same anatomical piece. Moreover, the vast majority (79.6% of cases) presented a diameter between 0.5 and 1 millimeter, while 20.4% of the cases had a diameter greater than 1 millimeter. Retromolar foramen are consistent and clinically relevant findings because they are associated with the passage of important neurovascular structures and should not be underestimated by clinicians.

P3-CS5

Morphological stenosis pattern of suprascapular notch in human concerning suprascapular nerve anatomical entrapment

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Suprascapular nerve entrapment in human due to anatomical stenosis of the suprascapular notch (SSN) is not rare, yet overlooked in clinical practice. The geometric anatomical complexity of the SSN was assessed to identify the morphological patterns of SSN stenosis in suprascapular nerve anatomical entrapment.
SSN space capacity was assessed by morphometric analysis of 252 dry scapulae. SSN parameters – superior transverse distance and middle width (horizontally aligned), depth, medial border length and lateral border length (vertically

aligned) –were measured. The probable SSN stenosis was estimated by referencing parameters to the suprascapular nerve range of diameter and quantifying the reduced parameters. Finally the pattern was determined based on the collective reduction of parameters alignments found in 45 SSN.

Type-I (depth larger than upper width) showed low incidence of stenosis (4/252) and low frequency within type (4/21) with potential risk of horizontal compression. Type-II (depth equal to upper width) showed relatively low incidence of stenosis (7/252) and low frequency within type (7/31) with undetermined pattern. Type-III (depth is smaller than upper width) showed relatively higher incidence of stenosis (41/252) but low frequency within type (41/129) with potential risk of vertical compression. Type-IV (foramen) showed low incidence of stenosis (4/252) and relatively lower frequency within type (4/16) with potential risk of encircled compression. Finally, type-V (discrete) showed relatively high incidence of stenosis (38/252) and high frequency within type (38/55) with potential risk of vertical compression. An osteoplasty of suprascapular margins may be required beside the common surgical approach of the superior transverse scapular ligamentectomy, especially when the nerve is compressed by bony margins horizontally.

All specimens belong to the anatomical collection of Charles University for research and education purposes, no additional ethical approval was required.

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P3-CS6

Will the real human lateral collateral ligament step forward as proven by Cadavers, MRI and Ultrasound?

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Original anterolateral ligament(ALL) term has been used to describe capsulo-osseous layer of iliotibial band(2007) and subsequently in 2013 given to yet another structure sharing proximal attachment of (fibular) lateral collateral ligament(LCL). Additional structure reported as ALL has become recognized and important in surgical and non-surgical musculoskeletal arenas associated with rotational knee stability, anterior cruciate ligament injuries, Segond fractures and posterolateral knee pathologies. LCL runs posteroinferiorly from its known attachments. ALL morphology has been described in multiple anatomical studies with debated descriptions. Authors designed anatomical ultrasound protocol(USP) identifying currently known ALL structure. Study objective was to confirm if ALL is actually part of the LCL and provide a proper clinical anatomy term supported by ultrasound, MRI and cadaver dissections. USP with 12, 18, and 22Hz linear ultrasound probes used to identify ALL in 10 unembalmed, 10 lightly embalmed and 40 traditionally embalmed cadaver knees(N=60). MRI was completed on 6 unembalmed knees. Dissection of donor cadaver knees was completed to reveal the morphology of the ALL(59:60). ALL identification noted on ultrasound and MRI were compared to morphology of ALL on dissection. MRI and dissection confirmed morphology of ALL as visualized on ultrasound imaging. ALL either shared the proximal attachment of lateral femoral epicondyle(44:60), branched from descending LCL(13:60), attached inferomedial(1:60) and no evidence of ALL(1:60). Distal attachment was consistently between anterior fibular head and Gerdy's tubercle(59:60,1-absent). ALL is now surgically repaired making terminology and imaging options important. Author's anatomical USP consistently identified ALL in non-injured knees. In summary, dissection, ultrasound and MRI successfully identified ALL, which shared proximal attachment or originated from LCL suggesting proper clinical anatomy terminology as anterior lateral collateral ligament(ALC), and current LCL as posterior lateral collateral ligament(PLC). When both share a proximal trunk prior to bifurcation, it be termed

common lateral collateral ligament(CLC). IRB approval granted for cadaver research.

P3-CS7

Denonvilliers' Fasica May Have Been Misidentified, but Denonvilliers' Plane Should be Recognized

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Unfortunately, rectal and prostate surgery is common and associated with chronic urinary and sexual dysfunction. Charles Pierre Denonvilliers dissected 12 male cadaver's for a predoctorate project published(1836) and awarded his medical degree(1837). Power of keen macro anatomy observation with kinaesthetic palpation sense was predominant scientific tool during dissection. Denonvilliers dissections revealed tissue(fascia) between prostate and rectum which carries his name-Denonvilliers fascia(DF). Interestingly, DF is extrapolated to exist between posterior vagina and anterior rectum in women. Much debate has occurred defining and establishing DF origin. Objective of this project was to provide broad view perspective of tissue termed DF, highlight data and controversies and suggest universally recognized surgical plane carrying his name. Regardless of origin, morphological tissue known as DF aids a surgeon when mobilizing lower rectum anteriorly in a relatively avascular plane. Cadaver dissections(18) and cross-sectional sheet plastinates were assessed. Literature search revealed recent sheet plastination studies elucidating DF as misidentified tissue in males and not seen in females. Lying within the prerectal space are leaf like sheets coalescing from 3 sources; 1.anterior leaf(s) formed from aponeurosis of external urethral sphincter; 2.posterior leaf(s) formed from peritoneal reflection aponeurosis of longitudinal anterior rectal muscle fibers; 3.sheets from neurovascular bundles. These 3 leaflike sheet or membrane sources are considered inaccurately termed DF and are not considered continuous with endopelvic fascia. To mobilize the rectum anteriorly, an incision of peritoneal reflection allows access to areolar prerectal space posterior to the DF. From here one can further enter a relatively avascular rectovesical or rectovaginal plane. DF was described as a single fascial layer. Regardless of study methods, greater numbers and studies are required to confirm or refute DF statements. Nevertheless, the relatively avascular plane which exists between the prostate/vagina region and the rectum should be termed Denonvilliers plane(DP). IRB approval granted for cadaver research.

P3-CS8

Pes Anserinus Concept of Hip, Knee and Foot Regions Provides Lower Limb Neuromuscular Control and Stereostructural Anatomy During Physical Examination, Ultrasound Imaging and Diagnostic Acumen

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Pes anserinus translates to goose foot. In the lower limb it resonates universally with an area of the medial knee including a bursa. Anatomically, it represents where three structures from three separate compartments often innervated by three separate nerves come together and attach to a shared bony region. The classic description is identified over the medial knee region or proximal anteromedial tibia specifically. Pes anserinus of the knee is not simply an oddity to mention during anatomy teaching; rather, it represents a region where proprioception from

each compartment contributes to mobility which ensures stability. The objective of this study was to identify other bony landmarks of the lower limb during dissection of lightly and traditionally embalmed bodies highlighting structures from three separate compartments sharing common attachment regions. The author has written and developed the medial line theme based on the concept that architecture of limbs is stronger or reinforced medially. On inspection and dissection (n=74) the classic pes of the knee has a deep example (anterior-vastus medialis m., lateral-medial collateral ligament, Postetior-semimembranosis m.). The iliac crest pes is Anterior-iliacus muscle, Medial-transversus abdominus muscle, Posterior-gluteus medius muscle. The greater trochanter pes is Anterior-vastus lateralis muscle, Medial-obturator externus muscle, Posterior-gluteus medius muscle. The foot or navicular pes is Anterior-tibialis anterior muscle, Medial-fibularis longus muscle, Posterior-gluteus medius muscle. The hip, knee and ankle have reinforced ligaments on their medial side. In summary, the Pes concept of 3 structures representing separate compartments sharing a common site of attachment exists throughout the lower limb including the iliac crest, greater trochanter, proximal anteromedial tibia and the navicular regions providing a recurring pattern not previously revealed. This study demonstrated a pes concept and medial line theme to augment anatomy teaching for improved understanding of the orchestration of limb structures for physical examination, ultrasound imaging, diagnosis and rehabilitation.

P3-CS9

Human Femoral Canal is Actually the Distal Segment of the Iliofemoral Canal which is a More Accurate Comprehensive Anatomical Term

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The femoral canal(FC) houses lymphatics within femoral sheath(FS). Generally FC is not defined in contemporary anatomy texts or is defined as the femoral ring, often considered the proximal end of the alleged FC, not representing the entire canal. FC is conventionally, but inaccurately, described proximally from femoral ring distally towards FS apex. For surgeons and radiologists this is not comprehensive or accurate enough. They engage an intra-abdominal proximal 'FC' region with different boundaries, critical when addressing femoral hernias. 20 million hernia repairs occur annually. Objective of this study was to define and delineate cone shaped 'FC'. Intra-abdominal and femoral dissections with and without laparoscopes on 5 unembalmed, 10 lightly embalmed and 26 traditionally embalmed cadavers(N=41) revealed 3 FC regions(abdominal, inguinal, femoral). 1.Abdominal boundaries are: Anteriorly-iliopubic tract(transversalis fascia), Medially-arching iliopubic fibers joining pectineal ligament on superior pubic ramus, Posteromedially-curving iliopubic tract and transversalis fascia and Posterolaterally-iliopubic tract with pectineus fascia, Laterally-fatty tissue/lymphatics covering external iliac artery. 2.Inguinal(femoral ring) boundaries are: Anteriorly-inguinal ligament, Medially-transversalis fascia/lacunar ligament, Posteriorly-pectineal ligament, Laterally-external iliac/femoral vein with septum of areolar tissue. 3.Femoral boundaries within FS are: Anteriorly-blended transversalis fascia/fascia lata, Medially-blended pectineal/iliacus/ transversalis fascia, Posteriorly-blended pectineus/iliacus fascia, Laterally-areolar tissue septum of femoral vein. Many authors only define femoral ring boundaries providing inaccurate perception of FC proper. FC abdominal opening boundaries are critical anatomy for laparoscopic hernia surgery. Inguinal aspect or femoral ring structures of FC maintain patency preventing collapse and/or resisting compression. FS region of FC tapers distally from femoral ring allowing venous dilation and lymphatic drainage. Sir Ashton Cooper was emphatic regarding anatomical detail of the amazing architecture of the 'groin' region. In

summary, medical technology and procedures have evolved placing FC within Iliofemoral canal improving clinical anatomy knowledge. Authors suggest universal terminology represent 3 regions of the Iliofemoral Canal. IRB approval granted for cadaver research.

P3-CS10

Teaching Important Anatomical Fundaments for the Clinical and Surgical Management of the Human Knee Joint

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Whenever we present the clinical interest to undergraduate students, we verify immediate growth in enthusiasm and commitment for the study of medical subjects, and for anatomy in particular, thus permitting gradual introduction of more complex, modern clinical knowledge. In the particular case of the knee joint, we offer our undergraduate students of the NOVA Medical School of Lisbon, a case-study of the fundaments of arthroscopy, before presenting them a regional anatomical piece for dissection. This teaching methodology is in accordance with the modern concepts of active training, in which the instructor collaborates with the students' construction of knowledge to build more enjoyable classes. At the NOVA Medical School (NMS), we work with innovative embalming techniques to prepare fully legalized human cadaveric material for undergraduate and postgraduate surgical training courses, with preservation of freshness and joint flexibility. The Regional Anatomy discipline enrols 50-70 students from the 4th semester of their Medicine course. They work in six groups around whole human cadavers, under supervision of practical tutors. Smaller teams of 2 to 4 students dissect each chosen region. In this case, the students showed interest for the dissection of the knee, with clinical application to sports medicine. They worked through ventral approach, with lower limb flexion. Within 6 weekly classes of 4 hours, these undergraduates managed to point out the specific anatomical elements of the knee joint with clinical and surgical interest for their future professional life. We concluded with a briefing on the main functional aspects with fundaments of sports medicine and physiotherapy in application to the case of football players' knees. Every human cadaver used in undergraduate and postgraduate courses at the NMS-Lisbon, corresponds to 'in vivo' donations, under Portuguese Legislation. All our courses are approved by the University Ethical Council. This is a pilot-study.

P3-CS11

Why do White Matter tracts matter?

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Traditional teaching in neurosciences used to put emphasis on importance of Gray Matter over White Matter for maintenance of neurological functions however recent understanding of White Matter tracts have altered its importance despite its heterogeneity and complexity.

Firstly, there has been a long list of anatomists who have enlightened us with the knowledge about these White Matter tracts. These include pioneers like Willis, Stenon, Malpighi, Vieussens and Vicq d'Azyr up to the beginning of 19th century. Subsequently, gross dissection of brain by novel approaches by Reil,Gall and Burdach highlighted its fascicular arrangement. Meynert proposed the tripartite organisation in to association, commissural and projection pathways. Then the detailed study was described by Dejerine and Dejerine-Klumke at the turn of 20th century that dominated our understanding for over a century.

Secondly, the technique of fiber dissection in postmortem human brains described by Klingler help us identify various White Matter tracts and this method has become one of the most

important part of neurosurgical training for safer practice in real.
More importantly, modern technique of diffusion tensor imaging with Magnetic Resonance delineates these tracts in great detail and this enables us to study the involvement of white matter tracts non invasively within clinical context.
This knowledge of white matter involvement is of paramount importance in the management of neurological as well as neurosurgical disorders. More specifically, pre-operative planning for neurosurgeons needs careful analysis of these White Matter tracts to maximise safe resection of tumours in eloquent areas. This is illustrated by practising neurosurgeons including Hugues Duffau (France) and Mitchel Berger (USA).
The author, who is a practising neurosurgeon with significant interest in teaching neuroanatomy, would like to triangulate anatomical dissections, pre-operative multimodal MRI studies including tractography and clinical course of patients with brain tumours. There would be additional input from other healthcare professionals.

P3-CS12

Sushruta - The Father of Surgical Anatomy

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The author of Indian origin belongs to a community who practised Ayurveda for centuries. Author conducted a detailed literature search on the subject of Ayurveda with special emphasis on its history. Due to author's surgical practice further study was conducted specifically focusing on the surgical science.
Sushruta (700 BC – 600 BC) is considered Father of Surgery who practiced Ayurveda (ancient system of medicine) in Varanasi. He also emphasized importance of understanding anatomy for practicing safe surgery.
Sushruta's compilation is called Sushruta Samhita. It is a comprehensive compendium with 184 chapters wherein study of anatomy is dealt with in the 10 chapters of Sarirasthana. Sushruta Samhita mentions the role of a student in the dissection.
Sushruta was a strong proponent of human dissection. He was the first one to establish preservation of deceased and cadaver dissection in scientific manner to better understand medical science. He had also highlighted certain criteria for selection of the body and then ascertained the method for its decomposition to study the structures layer by layer.
He has also described development of foetus and in his textbook there is mention about various congenial diseases as well as their treatment.
Sushruta has described the details of vascular anatomy since he seemed to have the knowledge of arteries described as 'channels'. Regarding skeleton he had classified bones according to their shape and size. It transpires that he had a thorough knowledge of fracture types, dislocations and sprains with their management.
He also had understanding of neuroanatomy in the sense that there were ten nerves carrying the impulses of sound, touch, vision, taste, smell, respiration, sighing, yawning, hunger, laughing, speech and crying. Further details are recorded.
Sushruta is credited for describing various surgical instruments however he also claimed that "the hand" is the most important and the best instrument.

P3-CS13

Numerical calibration of physiological effects

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Physiological effects, such as, due to the administration of drugs, are difficult to analyse and interpret mathematically due to its complex nature arising from the interplay of various factors. Unfortunately, this poses a significant challenge while evaluating and comparing multiple data sets, especially from clinical trials. Let us assume, a medicinal formulation of insulin showed a 50 % reduction from the starting blood sugar levels in ten normal and ten diabetic subjects after the same exposure periods. The

subjects, normal or diabetic, vary based on their body weight, gender, age, blood cholesterol, blood pressure, and endocrinal profiles. Within the current paradigm, it is difficult, if not impossible, to include all these physical attributes while calibrating the resultant decrease in blood sugar as an effect. The conventional mathematical analysis will find all these individual results to be similar despite missing the bigger picture. The realms of anatomy demonstrate the complex nature of the human body where the obtained effects are a cumulative output from multiple variants. Current machine learning tools are capable of analysing such complex physiological data sets influenced by multiple factors within the body e.g., body weight, blood cholesterol etc. This presentation will try to demonstrate the abilities of current computational tools to analyse/calibrate such effects (e.g., clustering, principal component analysis, neural network) and develop mathematical models, not only to evaluate/compare the data from different patients but, also, to predict the effect(s) under investigation. The poster will demonstrate the utility of such mathematical tools in addressing the current inadequacies and correlate it with the patient's physiology/pathology. The presentation will thus elucidate the complexity of interpreting physiological effects and will highlight the need to refine the current research methodologies. Necessary ethical approval was obtained prior to the study.

P3-CS15

Anatomical Study of The Masseteric Nerve in Humans Applied to the Masseteric-to-Facial Nerve Transfer: A Cadaveric Study

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Masseteric nerve is used as a nervous graft for facial reanimation with good aesthetic results. There is not much experience in this technique in our region, so an anatomical descriptive study of the topographic anatomy of this nerve applied to facial reinnervation surgery was performed. To describe the human masseteric nerve's anatomy in order to provide a reference to the surgeon during facial reinnervation surgery. This is a descriptive anatomical study of 15 masseteric regions of human adult cadavers, fixed in formaldehyde solution, where the topographic anatomy of the masseteric nerve was analyzed as well as descriptive anatomical aspects. In 12 cases the nerve was in relation to the posterior third of the zygomatic arch. Emerging through the mandibular notch at an average distance of 14.7 mm anterior to the mandible's condyloid process, and 8.8 mm from the inferior edge of the zygomatic arch. The relationship with the masseteric vessels was variable. The identification and dissection of the masseteric nerve was accessible using references described in the literature. We have added the relation between the nerve and the condyloid process (palpable structure next to the mandibular notch), and the variable relation of the nerve with the masseteric vessels. The topographic anatomical knowledge of the nerve is fundamental when it is approached and used as a nervous graft. Human Anatomy's Department of Medicine School (Facultad de Medicina - Universidad de la República), has an informed consent form for the donation of bodies for academic purposes.

P3-CS16

An anomalous left inferior phrenic artery in human cadaver and its clinical correlations

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The celiac trunk (CT) is responsible for supplying the structures originated from the embryological foregut and is normally composed by three branches: common hepatic artery, left gastric artery and splenic artery. At times, the CT has anatomical variations that can complicate intra-abdominal vascular and radiological surgical procedures. One of the reported variations is an atypical origin of the inferior phrenic artery (IPA). The objective of this study is to describe an anatomical variation from the IPA and to link it to clinical and surgical correlations mentioned in the current literature. This case presents an anatomical variation of CT found during a routine dissection of the abdominal aorta branches in a adult male corpse at the Federal University of Ceara (Brazil). After the dissection of three normal branches in the CT, the left IPA was found to be an anomalous branch. Its morphometry was measured in three different anatomic regions: from the origin to the diaphragmatic hiatus (42,91 mm); from the origin to the mediane plane (32,77 mm); and the artery's full lenght (78,64 mm). Despite the anatomical knowledge of CT, the number of vascular variations in that region is noteworthy and physicians should be aware of the difficulties that this may entail. The IPA is the most common source of extrahepatic collateral blood supply for hepatocellular carcinoma (HCC) and frequently supplies HCCs located in the bare area of the liver. Other pathologic conditions, including hemoptysis, diaphragmatic and hepatic bleeding due to trauma may be related to the IPA. Therefore, the knowledge of CT vascular variations and its relations to surrounding structures is also important from a surgical perspective. All cadavers were obtained from the Department of Anatomy, at the Federal University of Ceará, according to the institutional and national ethical and legislative guidelines (Law N° 8.501 of November 30, 1992).

P3-CS19

Bovine Aortic Arch; A novel risk factor for Berry Aneurysm

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Berry aneurysms (BA) are pathological dilatations of the circle of Willis (COW). Since ruptured BA's lead to life-threatening subarachnoid haemorrhage, prompt diagnosis and treatment is required.

The vessels supplying the COW originate from the aortic arch (AA) or a major branch. The normal AA pattern consists of three vessels, all of which contribute to the COW. Although described as normal, several variants exist, with the bovine variant (BV), consisting of two branches, accounting for 13%-15% in Ireland.

Most consider BVs as clinically silent. However, a recent paper showed an increased risk of thoracic aneurysms in patients with BV.

The aim of this study is to establish if patients with BV are at increased BA risk.

Ethical approval was granted by Galway Clinical Research Ethics Committee. All computed tomography cerebral angiography (CTCA) scans performed over a four-year period were retrospectively reviewed (n=1046). Patients without thoracic imaging and those with scans negative for BA were eliminated. Chi-square test was used to establish if the incidence of BV in patients with BA's differed significantly from background incidence.

Out of 1046 CTCA scans reviewed, 115 patients had a BA, of which 67 had thoracic imaging. Of the 67 patients, 28 had BV, accounting for 42% compared with 15% background incidence. $P < 0.001$ $x^2=26.87$, dF 1.

This study shows a statistically significant increased risk of BAs in patients with BV; a new finding which has not yet been documented in the literature.

P3-CS20

A case study of a rare aortic arch variation

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The brachiocephalic trunk arises from the arch of the aorta and divides into two branches: the right subclavian artery and the right common carotid artery. Variations in this structure can be seen as a result of an alteration during the embryological

development of the aortic arch. In a routine dissection of a male cadaver in the anatomy laboratory at Western Sydney University, we found a rare anatomical variation in the branches of the aortic arch. Only two large arteries arise from the aortic arch with the left common carotid artery arising from the brachiocephalic trunk. Since finding this case, another case was also discovered in our laboratory. Incidence in the literature is reported to be between 9 and 14%. The "common" branch has been referred to as bovine or common trunk and can be confused with the innominate artery considered to be the brachiocephalic artery. Thus this may be an opportune time to reduce confusion and rename the "common" artery as the brachio-carotid trunk when this variation is present. Awareness of these variations is essential during interventional radiology and neck and thoracic surgery, but especially important as three of the four vessels that supply the brain is contained in this trunk and disruption to the trunk may lead to dire consequences. Ethical approval from the Human Research Ethics Committee is not required as research on cadaveric material at Western Sydney University is governed by the Anatomy Policy which complies with the Anatomy Act 1977, the Human Tissues Act 1983 and the Public Health (Disposal of bodies) Regulation 2002.

P3-CS21

Bilateral multiple variations of muscles around the shoulder joint: A case study

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Anatomical variations in the muscles around the shoulder joint are increasingly becoming the norm rather than an exception. Because these muscles play a very important role in movement and stability, it is vital that studies are performed that explain the wide range of variations that occur. These variations also play a critical role during diagnosis in clinical practice. During a routine dissection of both the right and left shoulders of a 96- year-old embalmed female cadaver, bilateral variations were found in the coracobrachialis, deltoid, and infraspinatus muscle, while the biceps brachii muscle showed a unilateral variation. The coracobrachialis had a variable insertion from below the head of the humerus to its normal insertion. This constituted a much larger area of insertion than normal. In the deltoid, extra muscle fibres were observed travelling from the anterior deltoid to connect and insert with the superior fibres of pectoralis major, whilst a supernumerary head and variant origin were found in the biceps brachii. Finally, an extra muscular belly with transverse fibres was discovered in the infraspinatus muscles. Variations in the shoulder are common occurrences and can cause a number of clinical implications when it comes to diagnosis, treatment and post-treatment care of shoulder injuries. In this case study, more than one variation was found which is a rare occurrence and may cause confusion to the clinician in the case of injury. Adaptation to the environment at a young age may have caused some of these variations while some may be linked to genetic coding. Ethical approval from the Human Research Ethics Committee is not required as research on cadaveric material at Western Sydney University is governed by the Anatomy Policy which complies with the Anatomy Act 1977, the Human Tissues Act 1983 and the Public Health (Disposal of bodies) Regulation 2002.

P3-CS22

Morphological peculiarities of aberrant renal arteries and functional evaluation of renal hemodynamics in norm and in hypertension

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Knowledge as to whether asymmetry of renal haemodynamics is an inborn phenomenon or a result of hypertension is currently limited. In addition, there is debate about the possible role

of intact aberrant arteries in the development of hypertension. The purpose of our study was to detect variations in the morphology where aberrant renal arteries are present, as well as investigate right and left renal blood flow in normotensive and hypertensive patients. The inferior segments of 21 kidneys (12 with a single renal artery and 9 with an aberrant artery) were obtained from healthy men aged between 36-60 years at autopsy and were analysed using India ink injection and scanning electron microscopy investigation of the corrosion casts, histological, histochemical and morphometric techniques. In addition, Doppler renal investigation of 90 (38 normotensive and 52 hypertensive) right and left renal arteries of men at the same age period were performed (all kidneys were with a single renal artery). Our study of autopsy kidney segments with aberrant renal arteries has revealed a number of morphological variations, which may increase peripheral resistance to blood flow - were detected evidence of renal hypovascularity is present. Comparison of haemodynamic parameters of right and left kidneys in normotensive and hypertensive patients showed no significant differences; however, in hypertensive patients there was a significant increase in resistive index of renal arteries and decrease of its internal diameter compared with normotensive patients; acceleration time for renal artery was therefore prolonged. Patients with renal artery stenosis also have completely symmetric renal perfusion . Ethical approval was obtained from the local ethical committee of the Todua Research Institute of Clinical Medicine. There is currently no legal framework for obtaining ethical approval for Anatomical Examination in Georgia.

P3-CS23

The Morphology and Clinical Significance of the Extraforaminal Ligaments at the T1-T12 Levels Structured

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A dissection-based study of 10 embalmed human cadavers.

The purpose of this study was to describe the extraforaminal ligaments in the exit regions of the T1-T12 intervertebral foramina and to discuss their possible clinical significance.

Summary of Background Data: The ligaments at the lumbar intervertebral foramina have been well-studied. However, detailed descriptions of the extraforaminal ligaments at the T1-T12 levels are lacking.

Two hundred and forty T1-T12 intervertebral foramina from 10 embalmed cadavers were studied. The presence of the ligament was noted. The quantity, morphology, distributions, origins, insertions, and spatial orientations of the extraforaminal ligaments in the exit regions of the T1-T12 intervertebral foramina were examined. The length, width, diameter and thickness of the ligaments were measured with digital calipers by 3 independent investigators.

A total of 564 extraforaminal ligaments were identified in the 229 intervertebral foramina; no ligaments were found in the other 11 intervertebral foramina, resulting in an occurrence rate of extraforaminal ligaments of 95.42%. One hundred and thirty-six (24.11%) of the extraforaminal ligaments were radiating ligaments, and 428 (75.89%) were transforaminal ligaments. Radiating ligaments had a tendency to be abundant at T1 and T9-T12 and sparse at T2–T8. There were 245 (43.44%) ligaments at the anterior aspect of the exit regions of the intervertebral foramina, 225 (39.89%) ligaments at the posterior aspect, 64 (11.35%) ligaments at the inferior aspect and 30 (5.32%) ligaments at the superior aspect.

In the exit region of thoracic intervertebral foramina, there are 2 types of extraforaminal ligaments. They may serve as a protective mechanism against traction and play a role in the positioning of the nerves in the intervertebral foramen. Transforaminal ligaments may be an underlying cause of rib or chest pain after thoracic fracture and may be of clinical importance to surgeons.

P3-CS24

Bony landmarks to identify the Stylomastoid foramen in humans - A preliminary study

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This study aimed at identifying the location of the stylomastoid foramen relative to the Mastoid tip and the Tympanomastoid suture in a Sri Lankan population. This knowledge is important to the surgeon to localize the facial nerve as it exits the skull.

A total of 42 dry adult skulls from cadavers donated to the Faculty of Medical Sciences in University of Sri Jayewardenepura and University of Colombo for teaching and research purposes were analysed to measure the distance from the centre of the stylomastoid foramen(cSMF) to the tip of the mastoid(MT) and the lowest margin of the tympanomastoid suture(TMS). The angle between the anteroposterior line passing through the MT to the base of the zygomatic process and the line between MT to cSMF was also measured.

The mean distance between the cSMF and the MT was 1.3 ± 0.2cm with 1.2± 0.1cm on the right-side and 1.3±0.2cm on the left-side. In a majority 84.5%(71/84) cSMF to MT distance was 1.1-1.5cm with a range of 0.7cm to 1.6cm.

Between the cSMF and the TMS it was 0.9 ± 0.2cm with 0.8± 0.1cm on the right and 0.9±0.2cm on the left. In a majority 89.3%(75/84) cSMF to TMS distance was 0.6-1.0cm with a range of 0.5cm to 1.3cm.

In analysed skulls the angle was 61.4° ± 7.9 with 61.0^{o}±7.1 on the right and 61.7^{o}±8.7 on the left. Majority of the angles 26.2%(22/84) were between 56-60^{o} with a range of 43–80^{o} degrees.

In conclusion the knowledge on distances cSMF-MT and cSMF-TMS with the angle enable to locate the facial nerve trunk at the stylomastoid foramen. The distance from MT is similar to Indian studies but distance from TMS is higher than Indian and European studies. There is no statistical difference between right and left but further studies are needed to derive population values.

P3-CS25

“Porta hepatis” the place where human liver anatomy is defined

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I wanted to know the vascular anatomy of the liver because our findings in the routine academic dissections did not coincide with medical literature descriptions; for this reason, I dissected 250 necropsied human livers belonging to people of both sexes, all races and ages that fluctuated from fetuses to octogenarians. We use methods of acrylic injection in the portal vein, hepatic artery, common hepatic duct, inferior vena cava and hepatic veins (150 livers), in addition, we dissected 50 fresh livers and 50 fixed with formaldehyde. When dissecting the hepatic hilum (porta hepatis) we found: Division of the portal vein in right and left primary branches, these branches emitted seven secondary terminal branches for seven portal segments; hepatic artery proper and / or its replacements arrived and divided into two primary right and left branches, then these arterial branches emitted seven segmental terminal secondary branches; the segmental bile ducts were joined forming bi-segmental or tri-segmental trunks that finally formed the right or left hepatic duct. The secondary venous and arterial branches as well as the biliary branches formed seven vascular pedicles for seven portal segments in all cases (100%). All this happened inside the parenchymal canal of the porta hepatis, a channel formed by each and every one of the portal segments, where each of them receives their vascular pedicle. We conclude that the porta hepatis is the place where everything concerning the segmental vascular division of the liver happens. These findings will allow the improvement of liver surgical approaches and will make radiological readings more precise, as well as suggest a hepatic division in seven portal segments.

The study of organs and corpses in the Faculties of Medicine in Peru are allowed by the Ministry of Health and Justice, do not require legal permission or ethical statement.

P3-CS26

Anatomical bases for a new segmentation of the human liver: seven terminal vascular pedicles for seven hepatic segments defined at the "Porta hepatis"

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Results of our routine liver dissections in human anatomy classes did not coincide with what was expressed in anatomy texts schematic descriptions, for this reason we studied 250 necropsied human livers belonging to both sexes people, all races and ages (from fetuses to octogenarians), of these, 150 were acrylic injected before dissection; 50 were dissected in fresh and 50 were fixed with formaldehyde before dissection. Results demonstrated: 1) The porta hepatis is a parenchymal channel formed by each and every one of the seven portal segments, where they received their vascular pedicle and drain the produced bile. 2) The portal vein and hepatic artery proper were divided into right and left primary branches; left and right bile ducts converge to form the common hepatic. 3) Primary branches issued 7 secondary terminal branches for 7 segments, they entered their respective segment, always by the same place, whatever their origin. The left portal emitted segmental branches I, II, III and IV, right portal emitted branches V, VI and VII in 79% of cases; in 21% left portal emitted segmental branches I, II, III, IV and V, right portal emitted branches VI and VII. 4) The vascular pedicle secondary branches were terminal, creating "portal fissures". Each segment was characterized by being irrigated by terminal secondary portal and arterial branches, being separated by portal fissures due to the lack of anastomosis between the vessels that irrigate them and, conforming the parenchymal canal of the porta hepatis. It is relevant to offer the first definition of "liver portal segment", this allows us to identify seven portal segments in all livers studied. Research in human organs in the faculties of medicine of Peru is allowed without ethical declaration or legal permission, by the Ministries of Health and Justice.

P3-CS27

The V segment in the new portal segmentation of the human liver

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We wanted to know the anatomy of the portal segment V because some authors have proposed the existence of a variable number of liver portal segments. We supposed these differences lie in the way of describing the right medial segment (segment V), which has caused confusion when studying the anatomy of the liver, to investigate this we studied the vascular structure of 250 necropsied human livers of both sexes people, different races and ages (from fetuses to octogenarians), of this group 150 livers were injected with acrylic, fifty livers were dissected fresh and 50 fixed with formaldehyde; in addition, 50 adult patients of both sexes were analyzed by 3D reconstruction of CT images. The portal branch for segment V was the only one found for the right medial “division” of the liver, this branch was the most voluminous (10 mm diameter) among the seven segmental portal branches found. The branch for segment V, after penetrating 2 cm in the parenchyma, gave anterior, lateral, posterior and medial branches, which were distributed between right portal fissure and main portal fissure, from lower border of the liver to the inferior vena cava. The branch for segment V emerged from right portal branch in 79% of cases, in 21% emerged from left portal branch; in this case the left portion of the liver was more voluminous than the right. These findings led us to affirm that the vascular pedicle for segment VIII does not exist, there is no segment VIII (Couinaud segmentation), and it allowed us to propose a new portal segmentation with seven segments.

Ethical approval was not necessary to carry out this study in Peru

P3-CS28

Morphological and CT-based functional investigations of the glenohumeral joint in human body donors

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Osteoarthritic glenohumeral disorders may cause pain and an impaired range of motion, which ultimately leads to decreased quality of life. For the outcome of surgical treatment, radiological preoperative planning is increasingly important. So far, preoperative radiographic measurements of the shoulder joint only allows a rough estimation of the extent of arthritic deformation. In this interdisciplinary study on human cadaver specimens in the frame of the institutional body donation program, we examined the gleno-humeral joint by morphological inspection and analyses on CT data. Shoulder specimens from 20 male and 24 female body donors (aged 44-98 years, mean age 79.5 years) were isolated and graded using a modified Outerbridge classification applied to the shoulder by experienced shoulder surgeons. Additionally, CT data sets, which had been acquired prior to dissection, were investigated. As a first step, CT-osteoabsorptiometry (CT-OAM), which allows the determination of the mineralization distribution of the subchondral bone plate as a marker for the long-term loading history of joints, including the shoulderjoint, was applied. Results were correlated to the surgical classifications by two young scientists and were further discussed by experienced anatomists and shoulder surgeons. In selected pathologies, 3D-CT reconstructions of the glenohumeral joint were performed according to the method of Friedman as we described in a previous study. Preliminary data point to a pronounced correlation between the extent of osteoarthritic deformations or other defects as evaluated by both, the surgical gradings and the CT-based morpho-functional analyses. This study is one of the first to combine anatomical dissection with surgical gradings and CT-based functional analyses of the glenohumeral joint for the investigation of osteoarthritic disorders in an elderly population. Findings may serve as a basis for future studies on radiological preoperative treatment planning of shoulder surgery in patients with osteoarthritis.

P3-CS29

Can the femoral branch of the genitofemoral nerve be a possible reason for femoral nerve block failure?

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Anesthetic blocks of the femoral nerve at the level of the inguinal region might result in a block deficiency or failure in the innervation area of this nerve. One of the reasons could be that the femoral branch of the genitofemoral nerve has anastomoses with the femoral nerve in the femoral triangle.

In total 69 lower extremities embalmed with Thiel's method were investigated by dissection. All bodies donated to science arrived at the Chair

of Anatomy according to the strict rules of the donation program and styrian burial law. The course of the genitofemoral nerve as well as its branches were documented from level L2 at the medial margin of the psoas major muscle to the most distal macroscopically dissectible branch.
In three cases the femoral branch of the genitofemoral nerve, after running through the "lacuna vasorum" or vascular space underneath the inguinal ligament, sends branches to the femoral nerve 4 to 8 cm distal to the inguinal ligament. Two of these assembled branches reach down the medioventral thigh proximal to knee level. In another case, a nerve trunk sends small branches through the "lacuna vasorum" building anastomosis with femoral nerve branches. In 2 cases femoral nerve branches pass lateral to the iliopectineal arch with a distance to the femoral nerve trunk of up to 4 cm. These nerve branches fuse with branches originating from the trunk up to 10 cm distal to the inguinal ligament. A further case shows separate nerve branches superficial to the iliopsoas fascia but lateral to the artery.
In case of anastomoses with the genitofemoral nerve, femoral nerve blocks can fail. A safety block in the "lacuna vasorum" is recommended.

P3-CS30

Applied anatomy of the temporal region for injectable dermal fillers

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Out of all facial regions, the temporal region is amongst the first ones that changes with age. Specifically, the temporal fossae become concave due to volume loss owing to the disappearing and redistribution of the subcutaneous fat. As a consequence, when it comes down to facial rejuvenation, there are techniques that enhance the volume of the temporal region through filler injections, therefore, the knowledge of the anatomy of this region, especially of the temporal fascia layers, has a significant role.
By performing detailed dissections on a number of 6 cadavers, in the anatomy laboratory of the Carol Davila University of Medicine and Pharmacy, Bucharest, the following anatomical structures have been identified: the superficial temporal neurovascular bundle, the zygomaticotemporal and zygomaticofacial nerves, the facial nerve's branch for the orbicularis oculi muscle, and the sentinel vein of the lateral angle of the eye. A considerable amount of attention has been paid to the dissection and thorough description of the fascial system of the temporal region, as insufficient knowledge of this aspect can lead to improper administration of the fillers, in terms of volume.
After the dissection of the temporal fascia from its superficial surface towards the deep one, the dissection of the vessels of the temporal muscle has finally been achieved. The connections between the fasciae, their insertions and the communication channels between the temporal and middle region of the face have been observed.
The dissections were digitally photographed and edited, without altering the scientific content.
The dissections were performed in the dissection laboratory of the Anatomy Discipline, where the ethical conducts are regulated by Carol Davila University and fall under its jurisdiction. In Romania, the manipulation of cadavers is regulated by Law no.104/2003, which does not require special ethical conditions in order to accomplish dissections and to use the dissection images.

P3-CS31

Development of a biomechanical model of antero-posterior stabilisation of the glenohumeral joint

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The rotator cuff muscles are typically described as stabilizers of the glenohumeral joint through collective generation of a compression force to maintain congruence of the articular surfaces. However, a systematic review concluded that the most important stabilising characteristic of rotator cuff is to limit glenohumeral translation. Rotator cuff pathology is a major factor in instability and dislocation of the shoulder. This series of studies aimed to develop a biomechanical model of dynamic glenohumeral stabilization to improve understanding of the concept of the stabilizing role of the rotator cuff muscles.

The data was synthesised from a series of empirical studies (approved by the Human Ethics Committee) of participants with and without symptomatic rotator cuff pathology. The first study measured the effect of in vivo rotator cuff contraction on glenohumeral joint translation in 20 young healthy participants using real time ultrasound in a range of positions and conditions. The second study was a case controlled trial where the effect of rotator cuff contraction on glenohumeral joint translation was compared between 20 healthy controls and 20 age- and gender-matched participants with symptomatic rotator cuff tears.

The results suggest that contraction of rotator cuff muscles tethers glenohumeral joint translation in a direction- specific manner; and that the anterior glenohumeral ligaments block postero-anterior translation force, particularly in abducted shoulder position. These results are consistent with Panjabi's model applied to the shoulder, with both active and passive subsystems working to limit glenohumeral translations and the control subsystem causing reduced muscle activity and increased glenohumeral laxity in the pathological population due to central pain inhibition.

The proposed biomechanical model suggests that assessment and treatment of shoulder stability should be direction-specific. This biomechanical model serves as a clinical paradigm for the assessment and treatment of the rotator cuff muscle dysfunction that could form the basis of further research.

P3-CS33

Unusual multiple variations of upper limb arteries: a case report

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Variations in branching of the axillary artery and subsequent branches have been described in many studies. During routine dissection at the Department of Anatomy, Istanbul Faculty of Medicine, we observed multiple variations in upper limb arteries of a 64-year old embalmed Caucasian male cadaver. The first part of the axillary artery did not give any branches. The second part, after giving superior thoracic and thoraco-acromial arteries divided into deep and superficial brachial arteries. Superficial brachial artery gave lateral thoracic artery and continued into the arm. After giving anterior circumflex humeral artery, deep brachial artery trifurcated into subscapular, posterior circumflex humeral, and profunda brachii arteries. Understanding upper limb arterial variations are important. Our case would present a challenge during harvesting medial and lateral upper arm flaps, or donor vessels for coronary by-pass surgery. Ethical approval was obtained from the Clinical Research Ethics Committee of Istanbul Faculty of Medicine.

P3-CS34

Morphometric evaluation of radial recurrent artery

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Literature shows that most of the studies investigating the radial recurrent artery (RRA) seem to focus more on morphology of this artery. Accordingly, we aimed to evaluate the morphology and morphometry of RRA in detail

and highlight its clinical relevance with the obtained data. After obtaining ethical approval from the Clinical Research Ethics Committee of Istanbul Faculty of Medicine (number:1145; date:18.10.2017), 40 upper limbs of human cadavers were studied. The morphology of the RRA was evaluated according to its origin. The perpendicular distance of the artery to the intercondylar line and diameter of the artery at specific reference points were measured. The origin of the artery was radial artery (Type A) on 47.5%, root of radial artery (Type B) on 32.5%, brachial artery (Type C) on 17.5%, and ulnar artery (Type D) on 2.5% of cases. The perpendicular distance of the artery to the intercondylar line was 32.2±6.8 mm. The diameter of the RRA at the origin and the diameter immediately after the first branch were 2.5±0.5 mm and 2.0±0.4 mm, respectively. The distance from the origin of the first branch of the RRA to the RRA origin was significantly different between both sexes (p=0.039). There were no significant differences between sexes and sides for the remaining morphometric variables. The morphology and morphometry of the RRA may be a guide for surgeons performing free upper extremity flaps and interventional radiologists.

P3-CS35

Morphometric evaluation of anterior tibial artery

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Previous studies related with the anatomy of anterior tibial artery have focused mainly on morphology. Number of studies examining arterial morphometry is limited. Consequently, we aimed to examine the morphology and morphometry of the artery in detail. Ethical approval was obtained from the Clinical Research Ethical Committee (number:1144; date:17.10.2017). The study was carried out on colored silicone injected 30 lower limbs at the Department of Anatomy, Istanbul Faculty of Medicine. Morphological features of anterior tibial and popliteal arteries were assessed. Morphometrical evaluation included the tibiofibular trunk length, diameters of popliteal, anterior tibial, posterior tibial, fibular, and dorsalis pedis arteries and the vertical distances between anterior tibial artery origin to fibula head and tibial tuberosity. Popliteal artery branching morphology was determined as Type 1A in 80%, Type 1B in 10%, Type 1C in 3%, Type 2 in 3.3%, and Type 3 in 3.3% of all cases. Mean length of the tibiofibular trunk was 32.0±9.9 mm. Mean diameters of popliteal, anterior tibial, posterior tibial, fibular and dorsalis pedis arteries were 5.8±1 mm, 4.1±0.6 mm, 3.5±0.6 mm, 3.7±0.7 mm and 2.8±0.4 mm, respectively. Anterior tibial artery origin was 38±10.2 mm and 23.6±8 mm away from the fibula head and tibial tuberosity, respectively. Knowledge regarding anterior tibial artery anatomy and popliteal artery branching variations are essential for endovascular interventions around the knee, infrapopliteal by-pass procedures planned for peripheral arterial disease, and orthopedic operations involving tibial plateau. We believe that our results will help orthopedic and vascular surgeons.

P3-CS36

A preliminary study on the morphology of the fovea capitis femoris

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The fovea capitis femoris (FCF) serves as a landmark for hip arthroscopy and has anthropological importance. Number of studies on FCF mrphology, howeveri is limited. Therefore, this study was aimed to investigate the morphology of FCF. After obtaining ethical approval from Clinical Research Ethics Committee of Istanbul Faculty of Medicine, 79 (38 right, 41 left) femora with no record regarding age or sex from the collection of Department of Anatomy were evaluated. FCF shape, location, and presence of perifoveal grooves, notches, or osteophytes were investigated. The shape of the

FCF was circular, oval, triangular, and irregular in 39.2%, 39.2%, 15.1%, and 6.3% of cases, respectively. All FCF were located at the posteroinferior quadrant of the femoral head. More than half (56.1%) of the femora had a perifoveolar groove or notch and 30.3% had osteophytes around the fovea. FCF shape and presence of perifoveal groove/notch were not siginificantly different between right and left sides. Similarly, presence of perifoveal groove/notch was not siginificantly different among different FCF shapes. Detailed preliminary observations were carried out on the morphology of the FCF in a Turkish population. Further investigations on the relationship between FCF morphology and femoral morphometry including femoral neck angle and femoral torsion angle are planned.

P3-CS39

Translucent and Ultrasonographic Studies of the Inferior Labial Artery for Improvement of Filler Injection Techniques

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Lower lip augmentation by filler injections is an aesthetic procedure essential for the feminine look and enhance attractiveness. Injury to the inferior labial artery can produce an undesirable complication. This study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University (IRB No.528/60, COA No.032/2017). The translucent technique was used to study the sources of the inferior labial artery in eleventh cadavers. Ultrasound study in forty volunteers added supplement data to establish some recommendation for filler injections. Five types of inferior labial artery were described. These types were found in various combination patterns. Type 2 (Modiolar branch), 4 (Facial branch) and 5 (Superior labial branch) present a high risk for arterial injury during filler injections. Ultrasound study reveals a depth of 6 mm and the position of the artery at the vermillion border to locate the danger injection plane. The origins and courses of the inferior labial artery are classified into five types which can be found as a combination of many types in each face. These create combination patterns of variations. The physician should be aware of these variations during the aesthetic treatments or reconstructive procedures to avoid the dangers of accidental arterial injury.

P3-CS40

The optimal site for uterosacral ligament suspension: an anatomic study of female cadavers

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Uterosacral ligament suspension (USLS) is a surgical repair of posthysterectomy apical prolapse. Postoperative complications such as bowel and urinary events following the USLS have been reported. The aim of this study was to identify the relationship of the uterosacral ligament to the adjacent anatomy, particularly pelvic autonomic plexus, and to suggest the optimal suture site for USLS.

Dissection was performed in unembalmed female cadavers. All cadaveric objects in this study were donated legally to the Catholic Institute for Applied Anatomy. The location of ischial spine was regarded as the midportion of the uterosacral ligaments. Pins were placed at the midportion of the uterosacral ligaments (A), and at the points which were 1cm (B), 2cm (C), and 3cm (C) proximally located from the midportion.

Minimal distances from the uterosacral ligament to the autonomic nervous structures were measured.
In our results, autonomic nerve fibers were identified deeply and laterally to the uterosacral ligaments. Hypogastric nerves (HNs) formed the inferior hypogastric plexus (IHP) by conjugating with pelvic splanchnic nerves around the point C. From this point, the autonomic plexus, mainly composed of the IHP, ran deep and parallel to the uterosacral ligaments. The measured distance from the uterosacral ligament to the HNs at the point D was also presented.
Our study confirmed that the autonomic nervous structures were close to suture placement site for USLS. This would help clinician to understand the cause of postoperative morbidities following USLS. Via this study, the optimal site for suspension of the vaginal vault in the uterosacral ligament was suggested.

P3-CS44

The location and pathway of the risorius muscle in humans

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The risorius muscle is a muscle that plays an important role in the smile. Facial asymmetry or asymmetric smile caused by paralyzed risorius muscle can occur during the cosmetic procedures. Previous studies have reported on the location of the risorius muscle, but the exact pathway of the muscle has not yet been elucidated. In this study, we try to clarify the anatomical information of the risorius muscle based on the facial surface landmarks.
Twenty-five hemifaces from 16 embalmed adult cadavers (8 males and 8 females with a mean age of 77 years) were used in this study. After dissecting the skin and subcutaneous tissues of the lower face to expose the risorius muscles, the location of the risorius muscle was measured based on the cheilion (Ch) to the otobasion inferius (Oi) line.
On average, the upper and lower points of the risorius muscle were located 49.5 mm, 51.2 mm laterally from the Ch, and above 2.9 mm, and below 15 mm the Ch-Oi line, respectively. At the points of the lateral side of 2 cm, 3 cm and 4 cm from the Ch, the superior border of the risorius muscle was carefully located 8.3 mm, 9.9 mm, 8.5 mm below the Ch-Oi line, respectively. And the inferior border of the muscle was located 11.5 mm, 16.2 mm, 16.4 mm below the Ch-Oi line, respectively. The minimum distance from the mandible border to the risorius muscle was 12 mm on average.
The results of this study may provide a safe guideline for botulinum toxin treatment procedures of the lower face.
This study was conducted with conforming to the WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. All cadaveric objects in this study were legally donated to the medical school of Gachon University with consent.

P3-CS47

Novel aspect of the central cutaneous band of perineum and the superficial oblique perineal muscle

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Anatomy of the muscles of the superficial perineal pouch is important for the perineal approach, which is needed by surgeons to approach the urogenital diaphragm or prostate avoiding the perineal body. Previous reports showed variations of the superficial perineal muscular sheet which was not continuous with the perineal body. To clarify the anatomy of the perineal body, 20 male cadaveric pelvises were dissected under the operating microscope. After

removing the skin over the perineal region, the superficial anal sphincters, superficial transverse perineal muscle and the bulbosponsiosus muscle (BSM) were exposed and the alignment of the muscle fibers was investigated. We found the fibrous band connected between the cutaneous anal sphincter and the raphe of BSM. The average length of the band was 15.8 mm, the depth showed individual variation. Sometimes it had a continuation of fiber of the cutaneous anal sphincter. Perineal body was located under this band. Therefore, it can be used as a cutaneous landmark to find the perineal body. We named it as the central cutaneous band of perineum. Novel superficial oblique perineal muscle between the superficial transverse perineal muscle and the BSM of the proximal penile shaft was found in 60.0% of the cases. Average length of the muscle was 20.5 mm. The shape of the superficial oblique perineal muscle was variable: band, reverse V, or triangular shape. Most of these muscles inserted into the side or base part of the BSM. In one case, the triangular shape superficial oblique perineal muscle attached the raphe of BSM like as a tent. We considered the oblique muscle might support the erectile penis and it may assist elevation and backward retraction of the penis. The Act of Corpse Dissection and Preservation of Korea was observed throughout this study(#14885).

P3-CS48

Venous system of the digits and the hand: a human anatomical study and surgical applications

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While the importance of venous return restoration on the prognosis of digital replantation is fundamental, venous anatomy of the hand and digits is poorly known compared to arterial anatomy. Data available in the literature on the subject are scarce. The purpose of this descriptive anatomical work was to study the venous anatomy of the hand and fingers. Our series reports descriptive results from 7 hand dissections, from different fresh cadavers under the regulatory framework of the French Body Donation Program of the Lille University. Hands were previously injected with a colored 30% (n = 5) agar solution or latex (n = 2) before being dissected under optical magnification (x4). Each anatomical piece was photographed before being analyzed. Injections showed the venous system dorsal but also palmar. The venous dorsal system was more developed than the palmar venous system. There was a constant latero-nail vein on all long fingers and thumb. Finally, the presence of anti-reflux valves at the level of the middle phalange of the long fingers was observed. The knowledge, a priori, of the arrangement of the venous system of the hand and the fingers should help the surgeon when confronted with digital replantations, in particular distal (zones II and III of Ishikawa). No ethical approval was required for this cadaveric study.

P3-CS50

Anatomical basis for the selective block and other percutaneous procedures of the nerve to quadratus femoris

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Hip joint chronic pain can severely compromise patients' life quality. Peripheral nerve blocks play an important role as diagnostic and therapeutic procedures. The aim of this work is to study the anatomy of the nerve to quadratus femoris (NQF) in view of the possibility of its percutaneous selective block.

Forty-three gluteal cadaveric regions fixed in formaldehyde solution were dissected. The quadratus femoris, the obturator internus and superior and inferior gemellus were freed from their lateral insertion, exposing thus the posterior aspect of the hip joint. The NQF was identified, and the horizontal distance to the posterior edge of the greater trochanter at its upper, middle and lower thirds was registered. The number of the articular branches of the NQF was identified. Likewise, the horizontal distance to the posterior edge of the greater trochanter and the longitudinal distance to the bitroncantheric line were measured.

The distance between the NQF and the greater trochanter posterior edge at upper, middle and lower thirds was 46mm, 41mm and 35mm, respectively. In most cases (85%) the NQF presented one or two articular branches. The distances between the bitroncantheric line and the origin of the first, second and third articular branches of the NQF were 14.7mm (-19.4 - 40), 16.4mm (-9.3-42) and 27mm (0-46), respectively. The distances to the posterior edge of the greater trochanter were 43.1mm (16.3-66), 37.7mm (6.5-53) and 39.8mm (26-52), for the first, second and third articular branches, respectively.

The articular branches of the nerve to quadratus femoris have a constant and predictable distribution. Our findings allow for generating a coordinate system for the selective block of the NQF by way of percutaneous techniques.

P3-CS51

Medial Femoral Condyle vascular anatomy

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Moderate size bone defects (2-6cm) are a common reconstructive challenge. Nonvascularized bone grafts are deemed by the need for a healthy wound bed allowing unpredictable results. Vascularized bone flaps are an effective alternative for such defects. The adequate amount of bone, reliable vascularity and low morbidity make the medial femoral condyle a potential donor site.

Our aim was to perform a detailed anatomical study of the medial femoral condyle flap anatomy.

Anatomical dissection was performed on 7 cadaver legs at the Institute of Pathology. Surgical important variables were recorded.

Medial femoral condyle is nourished by the terminal branch of the descending genicular artery. The vascular pedicle mean length reaches 15 cm and arterial and venous calibers are 1.5mm and 2mm, respectively. The vascluarisation of the articular surface, as well as the presence of cutaneous perforators and muscular branches allows this flap to be chimeric.

Medial femoral condyle is a donor area specially suited for moderate size bone defects. A sound anatomical knowledge of the flap is essential for its surgical use, allowing benefits in terms of surgery time and reliability.

This study was performed in accordance to the Declaration of Helsinki. Ethics approval of was obtained by the Lisbon Central Hospital Center Ethical Committee.

P3-CS52

Review of the anatomy of the common digital arteries and nerves on a human cadaver

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Hand trauma is one of the leading causes of plastic emergency department admission. The knowledge of the precise course of vessels and nerves is of major clinical importance in order to evaluate the integrity of neurovascular structures in the face of common injuries. The hand arterial blood supply comes from the radial and ulnar arteries, which originate the superficial and deep palmar arches. These arches give rise to digital common arteries that bifurcate, supplying two pedicles to each finger. Accompanying these vessels, there are terminal branches from the ulnar nerve (5th and ulnar aspect of the 4th) and the median nerve (the remaining fingers) that provide sensitive innervation to the palmar aspect of the respective fingers. Classical anatomical description states that initially the nerve courses on the dorsal aspect of the artery and that at a variable point in the hand it becomes palmar to it. This crossing point and the bifurcation point of both the nerve and artery appear to be variable. In this study, we performed a detailed anatomical study in a single cadaver in order to better understand the anatomy of the palmar superficial arch and the digital nerves. Dissection with skeletisation of the referred structures and photographic documentation of the point where the common digital palmar artery and nerve bifurcate and of their relative positions in space were done. In our analysis, two clinically relevant conclusions were obtained in what concerns the common anatomy of the hand:First, the common digital artery is initially anterior to the nerve, until it bifurcates, gaining a more posterior position thereafter. Second, the digital nerve bifurcates more proximally (at the distal diaphysis of the metacarpal bone) than the artery (near the interdigital space).This study was performed according to the Declaration of Helsinki. Ethics approval of was obtained by the CHLC Ethical Committee.

P3-CS54

An intra-orbital study of the human orbit showing a single ethmoidal foramen for the transport of the neurovascular structures - a rare case.

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Anatomical landmarks of the medial orbital wall are vital for orbital surgery. Understanding of the medial orbital wall, the number, morphology and location of ethmoidal foramina is important in order to help reduce intraoperative risks. It is also important for proper identification of all anatomical structures during sinus surgery. The reported incidence rate of both minor and major orbital surgical complications varies between 0.5 - 30%. The aim of this case is to report the morphology of a rare variation of the ethmoidal foramen, present in the left orbit of one body.
Two orbits from one body were studied and revealed a rare variation. The eyeballs were exenterated from the orbits with part of the optic nerve, leaving the vascular supply and extraocular muscles intact. Further dissection was performed in both orbits to remove excess orbital tissue for proper visualisation of the orbital blood supply and their points of exit. Digital photographs were taken and stored on a computer. The arterial system was traced using Microsoft PowerPoint tools to highlight their route on the medial orbital. Ethical approval was obtained 469/2018.
The medial orbital wall of the left orbit was concluded to have a single ethmoidal foramen and two blood vessels were seen emerging from this single foramen in an unusual way. The right orbit did not show a similar observation. One previous study found a single foramen in four of 249 orbits, however, there was only one blood vessel that was seen passing through the foramen.
Knowledge of the medial orbital wall foramina may serve as a guide to clinicians while treating hemorrhages of ethmoidal vessels and anterior ethmoidal nerve syndrome. In addition, this knowledge will help to reduce intraoperative risks

and injury to the neurovascular bundle. Further research will be conducted to investigate the frequency of this variation.

P3-CS55

C1 Anatomic Variants in the Ancient skeletons of the Western Roman Cemetery of Valencia, Spain (2nd Century BC - 1st Century AD)

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The Western Roman Cemetery of Valencia, Spain served as burial site for the period between the 2nd Century BC and 3rd Century AD and was the burial site of the first inhabitants including its founder (Decimus Junius Brutus; cf. 138 BC). Currently there exists no information about the presence of anatomic variations observed in the atlas vertebra in the skeletal remains of the Western Roman Cemetery of Valencia, such the retrotransverse foramen (RTF), the arcuate foramen (AF), the unclosed transverse foramen (UTF) or the non-fused posterior atlas arch (NFPAA). Some variations, such as the AF or the NFPAA have been associated with the presence of clinical symptoms presenting after minor cervical spine or head injury such as acute headache, chronic tension-type headaches, migraine without aura, neck pain, vertebrobasilar insufficiency, vertigo and cervical myelopathy.
We analyzed 77 adult atlas vertebrae obtained from the Western Roman Cemetery of Valencia, Spain to assess the presence of the cervical variations of AF, of RTF, of UTF, and of NFPAA.
Eleven (14.3%) atlases presented anatomical variants. The AF was found in 2 vertebrae (2.6%), the RTF in 5 (6.5%), the UTF in 2 (2.6%), and the NFPAA in another 2 atlases (2.6%). All AF, RTF and UTF found were unilateral. Ten atlases (13.0%) presented only one anatomical variant while another atlas (1.3%) presented 2 anatomical variations. This latter atlas vertebra presented a NFPAA and an unilateral UTF.
This study has reported on the presence of anatomical variations of the atlas in the skeletons of a historical population of an ancient burial site in Valencia, Spain. These skeletons showed the presence of AF, RTF, UTF, and NFPAA, and also the occurrence of more than one anatomical variation in the same vertebra implying a presentation of associated clinical symptoms of this population.

P3-CS58

Communicating branches between median and ulnar nerves. Proposal for inclusion in Terminologia Anatomica

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The ulnar and median nerves are widely distributed, innervating the muscles of the forearm as well as the hand, where they also register the sensitivity of a significant part of the skin. A series of communicating branches (CB) is described on the path of these nerves, including: 1) the Martin-Gruber communicating branch, 2) the Marinacci communicating branch, 3) the

Riché-Cannieu communicating branch and 4) the Berrettini communicating branch. The aim of this study was to establish a correct nomenclature for these CB, using Latin and eliminating the use of eponyms. The exploratory study included books on anatomy and scientific articles that detailed the anatomical aspects of these CB. To these were added the terms used for these branches in the various anatomical lists and terminologies. Each term was proposed in Latin, using the corresponding gender, number and case. The CB between the median and ulnar nerves are described in anatomy texts as well as a plethora of publications. The prevalence rates of the CB range between 1.7 and 94 %; however, their inclusion in the anatomical terminologies has been limited. Based on the description of these branches and the presence of some of them in the existing terminologies, a proposal was prepared in line with the indications of the Federative International Program for Anatomical Terminology (FIPAT): 1) ramus comunicans cum nervo ulnari, 2) ramus comunicans cum nervo mediano, 3) ramus communicans cum ramo profundo nervi ulnaris y 4) ramus communicans cum nervo digitali palmari communi. Considering that terminologies are dynamic linguistic corpora, it is important to constantly analyze the incorporation of new terms that are in harmony with the scientific findings. The incorporation of new structures must follow FIPAT guidelines and include the grammatical aspects of Latin.

P3-CS60

Arterial Localization and Topography of the Anterior Upper Face: Implication for Eluding Complications Following Forehead Augmentation

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Dermal filler injection has been gained acceptance as minimal invasive procedure for facial rejuvenation. The forehead is one of common area for correcting unsmooth convexity, and the preperiosteal plane is recommended to perform the injection. However, severe complications following this plane injection have been reported. Therefore, this study aimed to investigate an arterial distribution and topography on the forehead to provide a proper guideline for enhancing the safety injection. This study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University (IRB No.786/61, COA No.149/2019). All cadavers were legally donated to the University, and all participants have signed the informed consent. Two investigating methods were utilized consisting of conventional dissection in nineteen embalmed cadavers and color Doppler ultrasonographic investigation in fifteen healthy volunteers to identify arterial distribution at the forehead correlate to anatomical reference lines. The supratrochlear and supraorbital arteries separated into superficial and deep branches after crossing supraorbital rim. The superficial branch traveled by deviating medially in subcutaneous tissue layer. The deep branch ran by deviating laterally in submuscular plane deep to corrugator supercilii and frontalis muscles and then penetrated them to travel in superficial layer at 25.1 ± 3.2 mm above the supraorbital rim horizontal line (SRHL). Moreover, the periosteal artery was found in preperiosteal plane above superciliary arch with diameter of 0.3 ± 0.1 mm. The medial periosteal artery arose from supratrochlear artery at 6.2 ± 1.3 mm above the SRHL, and the lateral periosteal artery originated from supraorbital artery at 12.2 ± 2.1 mm above the SRHL. After travel with a short distance, these arteries adhered tightly to bony surface and divided into branches on the periosteal surface. This study provides the crucial arterial localization and topography based on reference line system which could be considered for performing the safety forehead augmentation.

P3-CS61

Quantification of fat in the posterior sacroiliac joint region - is it of functional relevance for the sacroiliac complex?

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Fat is appreciated as a component of joints. However, fat in the posterior ligamentous region of the sacroiliac joint (PSIJ) to date has not been investigated nor considered to be of functional relevance. It is hypothesised that fat in the SIJ may be age- or pathology related. Pursuant to other joints, fat might function as a shock absorbing "cushion" for the incongruent surfaces, vessels and ligaments within that joint space. This study aims to investigate and quantify the presence of fat within the PSIJ.
66 hemipelves, were investigated and a subsample histologically analysed. Specimens were ethically obtained under the Human Tissues act of New Zealand (H17/20). Using Osirix, two volumes of interest were assessed, namely the total PSIJ volume and fat volume in the superior, middle and inferior sub-regions.
Males have smaller PSIJ volumes and fat content than females with no side difference. Fat volume correlates with age and PSIJ volume. Age and volume in the superior region correlate in females, and age and the inferior region in males. The middle and inferior regions of the right side had a higher fat volume than the left side. Females have more fat in the middle PSIJ than males. Age and fat volume in the middle and inferior regions correlate in males, and age and the inferior region in females. Fat percentage differed in the superior region between both sexes, independent of age and sides, and correlated with age in the inferior sub-region in females.
Fatty infiltration in the PSIJ is sex-dependant and age-related. It is thought to be linked with degeneration and serves a shock-absorbing role in the load-bearing and stresses subdued by the SIJ in the different sub-regions. Results may relate to post-partum stress in females and leg dominance between the sides to compensate forces the applied to the joint.

P3-CS64

Essential anatomical consideration for periodontal surgery

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In periodontal surgery, the negligent handling of the flap can potentially cause damage to the underlying muscles and nerves. Hence, knowledge of the anatomical structures' location is important. This study aims to clinically determine the position of the mentalis muscle, lingual nerve, and mental nerve. Twenty fresh Thai cadavers, age over 21 years old with bilateral lower lateral incisors or lower posterior teeth, at least 2 teeth in the same quadrant, no mandibular fracture and pathology, and no extruded or intruded teeth more than 1 mm were used. This study was approved by Ethics Committee on Human Specimens Research, Khon Kaen University, Thailand (HE611458). A digital vernier caliper was used to measure the distances between the origin of the mentalis muscle to the cemento-enamel junction (CEJ), the width of the origin of the mentalis muscle and the mental foramen to the CEJ. In addition, a UNCP-15 periodontal probe was used to measure the

distance of the lingual nerve to the internal oblique ridge (IOR) at the coronoid notch level. The distances between the origin of mentalis to the CEJ on the right side was 6.06±1.12 mm and the left side was 6.12±1.27 mm. The widths of the origin of the mentalis muscle on the right and left sides were 12.93±3.30 mm and 13.11±2.90 mm, respectively. The distances between the superior border of mental foramen to CEJ on the right was 16.85±2.40 mm and the left was 17.88±3.10 mm. The distances between the lingual nerve to the IOR at coronoid notch level on right and left sides were 2.35±2.37 mm and 2.90±2.86 mm, respectively. In periodontal surgery, such as gingival augmentation and distal wedge procedure, the knowledge of the precise location of the mentalis muscle, mental foramen and lingual nerve can increase confidence to design flap and prevent incidental anatomical damage.

P3-CS68

An Azygos Lobe of Right Lung-A Cadaveric Study

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The azygos lobe is a rare anatomical variant, most often encountered in the right lung.Its prevalence in the clinical setting is 0.4%, and 1% in anatomical dissections.Its etiology is related to a defect of the migration of the azygos vein during the embryonic development.Anatomical knowledge of morphological variations of lobes and fissures are essential for Cardiothoracic surgeons in identifying bronchopulmonary segments and for performing lobectomies and surgical resection of individual segments and for Radiologists interpreting X – rays, CT & MRI scans.The detection of this anomaly and clarification of its precise anatomical features are important not only to differentiate this anomaly from other pathological conditions, but also to alert the surgeon to potential problems during surgery.The study material comprised of 22 human cadavers,over a period of 2 years.Out of 44 specimens,1 specimen showed an azygos lobe in the right lung in apical region.The findings being laterally displaced azygos vein which created a deep pleural fissure into the apical segment of the right upper lobe due to invagination of the azygos vein and pleura,azygos vein crossing from left to right side in posterior mediastinum,in situ lobe was placed posteromedially .Left lung was normal.Clinically, the knowledge of azygos lobe anatomy is essential to know the location,morphology and prevalence for diagnostic and surgical procedures of the lungs related to mediastinal pathologies, especially to minimize intraoperative vascular injuries, shock,and sometimes the possibility of pulmonary torsion.
Ethical approval was taken from Department of Anatomy,OMC.

P3-CS69

Morphological Variation In Azygos Vein

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The variant azygos venous system might be confused with thoracic aorta aneurysms, lymphadenopathy and tumours of posterior mediastinum. The anatomical knowledge of the variability of the azygos venous system is important for the surgical interventions of the posterior mediastinum and also during radiological investigations/diagnosis especially CT and MRI. The present study was undertaken on 22 embalmed adult human cadavers irrespective of age,sex over a period of 2 years.In this study,during the dissection of posterior mediastinum,azygos system of veins was observed in 22 dissected specimens.Out of which 6 cadavers showed the variation.In this,a total of normal azygos venous system was found in 16 specimens accounting for 73%.Variations were found in 6 specimens (27%); all specimens presented with shifting of azygos vein towards left of vertebral column with presence of normal positioning of accessory hemiazygos vein and hemiazygos vein, 2 transverse channels across vertebral column.Accurate knowledge about this kind of variation is very important to identify, especially in the computed tomography and

magnetic resonance imaging of mediastinum. The abnormal azygos venous system may easily be confused with aneurysm, lymphadenopathy and other abnormalities like tumour. It is important to keep these kinds of variations in mind while performing the mediastinal operations or surgery of large vessels.
Ethical approval was taken from Department of Anatomy,OMC.

P3-CS70

Anatomical study of the compositions and internal connections of the chiasma plantare: explore its clinical impact

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The object of this study was to integrate the types of interconnecting fibers among component of the chiasma plantare, as well as to deduce their flexion actions. The chiasma plantare and the long flexor tendons in both feet of 26 cadavers were dissected and removed using gross anatomical dissection. All of these individuals had donated their bodies to medical education and research at the department of Anatomy Yanbian University. In addition to informed consent of the deceased individuals, the study was approved by the Ethics Committee of the Medical College of Yanbian University. The connections among the QP, FHL, and FDL were then classified and analyzed. Connection between the FHL and FDL: 43 cases as type I (86%), 2 cases as type III (4%), and 5 cases as type V (10%), with FHL manipulating 1-3 toes and FDL 1-5 toes. Shape of the QP: 28 cases (56%) exhibited a two-headed QP, and 22 cases (44%) with medial-headed QP. Composition of the chiasma plantare: two layers 28 cases (56%), and three layers 22 cases (44%): 9 cases (18%) as type a, 2 cases as type b1 (4%), and 1 case each was classified as type b2 and b3. FHL controlled the second toe in 10 cases (20%), both the second and third toes in 27 cases (54%); the second, third and fourth toes in 13 cases (26%). QP manipulated third and fourth toes in all cases, second toe in 38 cases (76%), and fifth toe in 11 cases (22%).All above suggested that such variations might result from tendon transfer. In conclusion, we considered that FDL was with more advance for both recovery of ankle and forefoot based on this study.

P3-CS72

Postnatal growth of the nasal cavity and its relationship to the paranasal air sinuses (PAS) in a South African paediatric population using computerized tomography

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The morphology of the PAS may be affected by anatomical variations of the nasal area particularly, the nasal septum and turbinates. Nasal morphology is established at birth and emphasized postnatally, however, the link to PAS growth across populations and sex needs further evaluation. Furthermore, limited studies have described the variations of the nasal area using computerized tomography (CT) imaging as a modality. Therefore, the aim of this study was to assess the growth of the nasal cavity in relation to the PAS in children and early adulthood. CT scans (n=480) were reviewed from public and private sector hospitals (KwaZulu-Natal (KZN), South Africa). The sample consisted of 276 males; 204 females; 1-25 yrs of age representing the two main population groups (viz. Black African and White). Linear parameters of the nasal cavity (viz. nasal width and height), soft tissue structures (viz. length and width of the nasal septum and turbinates) and PAS (length, width, height) were recorded using 3D Slicer. Multiple regression analysis was used to evaluate the relationship of these parameters. Ethical clearance was obtained

from the University of KZN Biomedical Research Ethics Committee (BE247/11) and Department of Health, KZN. The results indicated a weak correlation between the linear parameters of the PAS and nasal cavity (r^2<0.460). Peak growth occurred after 7 to 9 years of age for the nasal parameters except nasal septum width, nasal cavity (midway) and the superior nasal concha. The mean linear parameters were higher in males than in females. Statistically significant differences between the population groups were observed for the inferior nasal concha length, nasal septum and nasal cavity (anterior) widths. The morphometric data provided insight on how these structures grow in relation to each other. Additionally, the data may be clinically useful for surgical planning of patients undergoing endoscopic sinus procedures.

P3-CS73

Femur Spiral Line: Characteristics and Anatomical importance

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At the proximal division of the linea aspera of the femur, three divergent lines originate. Of these, the medial line constitutes the enthesis that origins the vastus medialis muscle, that despite being described in anatomical texts, as a linea espiral (LE), its use is confused and it is not correctly incorporated in Terminologia Anatomica. The aim of this study was to describe the human femur LE characteristics and its relations with others bone anatomical formations. Dry femora of 65 adults were studied, without distinction of sex, belonging to the Universidad de Playa Ancha, Chile. This study was approved by the Ethics Committee of the foresaid University. Osteometric board, tape measure, goniometer and digital caliper for measurements were used. Data was analyzed with STATA®15 Software.
100 % of the analyzed bones presented LE, with 93.7 ± 14.4 mm length and 4.8 ± 1.5 mm thickness. The femur anatomical length was 436.8 ± 27.0 mm and its inclination angle was 135.8 ± 5.1 mm. A direct and moderate relation existed between LE and femur length (p <0.01), and with the femoral head inclination angle (p <0.02). When referring to the femoral head, there is no significant difference between the origin of LE and the nutritional foramen. Similarly, there is a direct and moderate relationship between these two variables and the length of the LE (p <0.000).
If we consider the prevalence of this enthesis and its relationship with other anatomical structures, its use in anatomical bibliography and scientific publications, as well as its usefulness to determine the origin of the vastus medialis muscle, it is conferred to this enthesis an anatomical, anthropological and clinical value. Therefore, we evidence basis in our work to consider the incorporation of the term linea spiralis to Terminologia Anatomica.

P3-CS75

Anatomy of the Lingual nerve: Application to oral surgery

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The purpose of this research is to obtain morphological information of the lingual nerve regarding the traveling route, branching pattern, and its distribution within the tongue, all of which are important when performing oral surgical procedures. Using twenty sides from ten Japanese cadaveric heads, we observed the lingual nerve from the merging point with the chorda tympani to the peripheral terminal in the tongue. We focused on the collateral branches in the area before reaching the tongue, as well as the communication between the lingual and hypoglossal nerves that reached the tongue. The collateral branches of the lingual nerve were distributed in the oral mucosa between the

palatoglossal arch and the region of mandibular molar. Two to eight collateral branches arose from the main trunk of the lingual nerve, and the configuration of branching was classified into three types. More distally, the lingual nerve started to communicate with the hypoglossal nerve prior to passing the anterior border of the hyoglossus muscle. The nerve communications were also found in the main body and near the apex of tongue. A thorough understanding of the collateral branches in proximity to the tongue, as well as the communication with the hypoglossal nerve inside the tongue, will be of significance for preventing functional disorders from local anesthesia and oral surgical procedures associated with the lingual nerve.

P3-CS76

Three-dimensional topography of the human auditory ossicles for effective malleostapedotomy

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Malleostapedotomy for the patients with the otosclerosis is a otologic surgical procedure involving attachment of a prosthesis that grips the malleus handle on one end and passes through the base of the stapes into the vestibule on the other end. The difficulty associated with this procedure is to determine the proper prosthesis sizing and shaping by intersubjective variability. The present study investigated the positional relationship between auditory ossicles and other structures of the middle ear using computer aided 3-D volume rendering with purpose of providing surgical guidelines for the safe and effective mealleostatpedotomy. Fifty-one sides of the temporal bone were scanned by MicroCT and the auditory ossicles and the tympanic membrane were materialized three dimensionally in Mimics software. The mean distances from the grip site of the handle to the umbo, from the umbo to the long crus of the incus, and from the long crus of the incus to the base of the stapes were 3.6, 2.5, and 3.7 mm, respectively. The mean distance from the grip site of the handle to the base of the stapes was 6.5 mm. The mean thickness of the base of the stapes was 0.2 mm. The mean angle between the tympanic membrane and the base of the stapes was 10.7 degrees. The mean angle between the horizontal line of the grip site and the long crus of the incus was 35.4 degrees. The present study has identified the positional relationship between tiny structures involving sound transmission in the middle ear via 3D volume rendering, and has also yielded new navigational guidelines that will facilitate adequate prosthesis sizing and shaping during malleostapedotomy. No ethical approval is required to perform the present study.

P3-CS77

A morphometric analysis of the immature human infra-orbital canal

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The infra-orbital neurovascular structures play a vital role in the development and growth of the immature maxilla and the associated midfacial region. The infra-orbital canal serves as an important conduit for the nerves innervating midfacial structures. The development and growth of the canal is however, not well understood. A comprehensive analysis of the morphometry of the infra-orbital canal, particularly during the late prenatal and early postnatal periods, may contribute to an understanding of both normal and abnormal maxillary growth during this period of time. The aim of this study was to describe changes in the morphometry, the integrity of the walls and the branching pattern of the infra-orbital canal during the late prenatal and early postnatal stages of growth. A total of 50 human fetal and neonatal maxillae (18 skeletonized crania and 32 cadavers) were utilised. The sample included 27 late prenatal individuals (30 gestational weeks and birth) and 23 early postnatal individuals (birth and 1 year). Ethics approval to utilise the skulls of

skeletonised individuals for this study was obtained from the University of the Witwatersrand's Human Research Ethics Committee (Medical; W-CJ-140604-1). Maxillae were scanned using a Nikon XTH 225 L micro-CT unit and analysed using VG studiomax v3.2. Measurements included the maximum width, height and surface area of each foramen associated with the infra-orbital canal and the total length of the canal. The integrity of the canal walls and the branching pattern of the canal were also analysed. All the measurements of the canal were larger in the early postnatal group when compared to the late prenatal group, while the walls and branching pattern of the canal were better developed in the postnatal group. The morphometry of the infra-orbital canal reflected the developmental stage of the associated structures such as the dentition, maxillary sinus and orbit.

P3-CS78

Sexing Using Tooth Widths in Thai Population

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Sex determination for personal identification is the initial step when the anonymous was found. Unfortunately, in some circumstances such as, skeletonized body, it cannot determine the sex by soft tissue. In these cases, tooth is an alternative tool in sex prediction because of its hardness and difference in size between male and female. This leads to the aim of this study to develop the sex prediction equation from the tooth widths. Four hundred ninety-seven pairs of Thai dental casts (186 males and 311 females) were selected. All upper and lower casts present 14 normal morphology and fully erupted teeth (except third molar). The mesiodistal width of each tooth was measured using vernier calipers. The independent samples t-test was found that all tooth widths were statistically different between sex at 0.05 significant level. The sex prediction equation using tooth widths was developed by binary logistic regression analysis. The final equation composed of 10 tooth widths: upper right and left first molar, upper right canine, upper left central incisor, upper left first premolar, lower right and left lateral incisor, lower right and left canine, lower right second molar. Then another 180 pairs of dental casts (90 males and 90 females) were used to determine the accuracy of the sex prediction equation which is 74% correct for sex prediction. In conclusion, tooth widths can be another tool for determine sex by the sex prediction equation with high accuracy.
The ethical approval was certified by Faculty of Dentistry/Faculty of Pharmacy, Mahidol University, Institutional Review Board.

P3-CS80

The Vascular Territory of the Superior Auricular Artery in Human Cadavers

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Retroauricular flaps based on the superior auricular artery (SAA) are used frequently although their vascular basis is not well understood. Flap tip necrosis and venous congestion occur. This study aims at investigating firstly the vascular territory of the SAA and secondly the superior auricular vein (SAV). Four fresh-frozen human cadaveric heads were studied following the guidance set out by the Human Tissue Act. Dissection of the branches of the external carotid artery was followed by pink and green coloured latex injections in the superficial temporal artery (STA) and the posterior auricular artery (PAA) respectively. Dissection of the vascular network of the auricle and the periauricular region was performed under loop magnification. Pictures were taken and used to

create representative drawings of the vascular network. The SAA was present in all specimens. It originated from the parietal branch (62.5%) or the main trunk (37.5%) of the STA with an individual origin cranial to the tragus in 87.5% and a common trunk caudal to the tragus in 12.5%. The SAA split into up to five branches that travel towards the (1) helical rim (100%), (2) tragus (66%), (3) triangular fossa (83.3%), (4) posterior auricular surface (83.3%) and (5) temporal region (66%). The SAA anastomosed with the anterior auricular arteries (AAA) over the tragus (66%), and with the PAA over the helical rim (100%), superior third of the auricle (83.3%) and auriculo-temporal groove (33%). The SAV was separated from the SAA by the superior auricular muscle in two specimens and, in general, followed a course separate from that of the SAA. The SAA is not as predictable for retroauricular flaps as described in textbooks. Further anatomical research, a systematic review, and a meta-analysis of both anatomical and clinical studies on retroauricular flaps are recommended.

P3-CS82

The anatomical basis of the sensate deep inferior epigastric perforator (DIEP) flap

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The DIEP flap can be used for a variety of reconstructive procedures when a large segment of soft tissue, including fat and skin is necessary. It is particularly popular for breast reconstruction. Although there is some degree of spontaneous recovery of sensitivity in the flap after surgery when no nerve coaptation is performed, this recovery is still inconsistent. Sensation of the flap is an important factor to prevent burns and other injuries and improve patient satisfaction.
The present study aims to describe the nerves supplying the DIEP flap and identify the ideal nerves for the design of a neurotised DIEP flap.
An observational cross-sectional study was performed on 12 formalin-preserved hemicadavers at the Institute of Anatomy, Lisbon Faculty of Medicine, Portugal. Dissections began by tracing the nerves exiting the DIEP flap through the preaponeurotic planes. Next, nerves T10-12 were followed through the neurovascular plane of the abdominal wall, as they penetrated the rectus abdominis (RA) muscle and terminated as cutaneous branches in the flap. A detailed mapping of the branching patterns and interconnections was carried out. Multiple histological specimens were taken to confirm the presence of neural tissue, measure nerve diameter, and quantify the number of sensitive and motor fibers.
This study was performed in accordance to the Declaration of Helsinki. Ethical approval was not required.
Small sensory nerves were identified leaving the periphery of the flap in the pre-aponeurotic plane. The deep nerves reach the flap after perforating the RA and its fascia. Although of a larger calibre, these are often accompanied by vessels, may exhibit motor fibers, and their dissection is more complex.
Detailed understanding of the DIEP flap neuroanatomy may allow neurotisation of the flap during reconstructive procedures, without significantly increasing the complexity and risks of surgery.

P3-CS83

The anatomical study of the nerve supply of the breast, including the nipple and areola – Implications for surgery

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Primary evolution in mammoplasty focused on achieving the aesthetic and reconstructive goals while preserving tissue viability. Surgery today involves preserving not only tissue viability but also function in terms of sensation, especially in the nipple-areola complex (NAC), as it is a valuable part of women's psychological and sexual health. The literature regarding primary innervation of the NAC is scant and contradictory.
The present study aims to perform a detailed anatomical study of the sensitive nerves of the breast necessary to develop appropriate surgical techniques witch preserve nipple and areola sensation after mammoplasty.
An observational cross-sectional study was performed on 12 breasts from 6 formalin-preserved cadavers at the Institute of Anatomy, Lisbon Faculty of Medicine, Portugal. Firstly, the supraclavicular branches from the cervical plexus were identified and traced above the clavicle. After that, the anterior and lateral cutaneous branches of the intercostal nerves were identified as they emerged through the deep fascia, and carefully microdissected to their endpoints in the breast.
Multiple histological specimens were taken to confirm the presence of neural tissue, measure nerve diameter, and quantify the number of sensitive fibers. Ethical approval was not required.
The breasts received innervation from the supraclavicular nerves, and from the lateral and anterior cutaneous branches of the second to the sixth intercostal nerves. The NAC was innervated mainly from the fourth intercostal nerve, with additional contribution from the immediate inferior and superior intercostal cutaneous branches. Among the nerves that reach the nipple, the lateral branch of the fourth intercostal was the one with the largest diameter and the greatest number of fascicles. Avoidance of dissection in this area may maximize the chances of retaining sensation in the NAC after breast surgery.

P3-CS85

A novel adaptation of Latini's modification of Klinger's method of cerebral hemisphere preservation to develop a white matter dissection course for neurosurgical trainees

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Modern imaging techniques e.g. MRI tractography have reinvigorated interest in white matter tract (WM) anatomy. Latini et al (2015) modified the original Klinger's (1935) WM dissection technique; embalming the brain via carotid arterial perfusion followed by freezing which allows grey matter removal exposing underlying WM. Ethylene glycol in the Aberdeen embalming solution however interferes with freezing. We therefore modified this technique, facilitating brain preparation whilst embalming the remainder of the cadaver using standard protocol.
Upon arrival in Anatomy, 5 cadavers were decapitated and heads exsanguinated. The remainder of each cadaver was embalmed as per normal. A 12% formaldehyde solution was introduced into the carotid arteries using a peristaltic pump until ocular-bulb fullness. After 48 hours, brains were extracted, dura removed and brains suspended in 10% formaldehyde (24 hours) before washing (24 hours). All meningeal structures were then removed, hemispheres separated and frozen (-15°C) for at least 10 days. Before use, hemispheres were thawed under running water (24 hours).
10 neurosurgical trainees attended a two-day course (June 2019); one cerebral hemispheres per participant were dissected and WM identified. 9 of them completed a feedback questionnaire (eleven 5-point Likert scale questions and free text comments). 100% respondents strongly agreed about the excellent specimen quality; 78% strongly agreed and 22% agreed that the course

aided surgical skill improvement. Free text comments included “Excellent opportunity to dissect” and “Fantastic specimens”.
Our technique allowed us to deliver the first Scottish WM cadaveric dissection course. The success of the course highlights how strong collaboration between clinicians and anatomists can provide invaluable opportunity for trainees to gain an understanding of clinically relevant anatomy and thereby improve postgraduate training.
Bequeathed human cadaveric material were maintained in accordance with Anatomy Act 1984 (as amended by HTA (Scotland) Act 2006). Course participants’ completion of questionnaires was optional, consent implied.

P3-CS92

Tortuosity of the Vertebral Arteries in a Select South African population

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We report on three cases (ethical approval from Biomedical Research Ethics Committee of the University of KwaZulu-Natal with ethical No: BE 148/19) of bilateral tortuosity of the vertebral arteries (VA) in 2 Indian male and 1 Black female elderly South African patients, respectively found incidentally on computed tomography angiography scans of the neck and intracranial vessels. The VA is divided into four segments viz. VI (extends from the origin at the subclavian artery to the level of entry of C6 foramen transversarium), V2 (extends from transverse process of C6 to C2), V3 (extends from C2 to penetration of dura at foramen magnum) and V4 (extends from foramen magnum to union of contralateral VA). In all reported cases, tortuosity occurred at V1 and V2 segments leading to a significant and potentially dangerous medial or lateral artery displacement. The VA looped into the vertebral body of C2, C4, C5 and C6 cervical vertebrae. In two of the three patients, the internal carotid arteries were occluded. One patient presented with stenosis of the proximal basilar artery. Tortuosity in the vertebrobasilar artery can result in poor blood supply to the brain, leading to clinical symptoms of transient ischemic attack. The mechanisms resulting in vertebrobasilar artery tortuosity remain unclear. It has been reported that vertebrobasilar artery tortuosity is associated with connective tissue disorders, reduced elasticity and degeneration of blood vessels, and vascular wall shear stress.

P3-CS93

Bilateral tripartite dural septation of the jugular foramen: a case report

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We present a case of bilateral tripartite dural septation on the internal aspect of the jugular foramen in a 71-year old white South African male (Ethical clearance number BE273/18). Dura mater at the intracranial aspect of the jugular foramen forms the neurovascular compartment which houses the cranial nerves (viz. glossopharyngeal (9th), vagus (10th) and accessory (11th) cranial nerves), as well as the jugular vein. In the present case a dural septation was seen between the 9th and 10th cranial nerve, and between the 10th and 11th cranial nerve; therefore, the 9th cranial nerve traversed the anterior compartment, the 10th cranial nerve traversed the intermediate compartment, and the 11th cranial nerve traversed the posterior compartment. Clinical implications of this variation of the jugular foramen arise due the occurrence of glomus jugulare tumours, as well as other pathologies such as meningiomas and neuroinomas, these tumours occur at the region

in which the neurovasculature exits the cranium. The tumours then lead to compression of these structures within the foramen resulting in syndromes such as Vernets syndrome, and the loss of hearing. Since two dural septa at the intracranial aperture of the jugular foramen are reported bilaterally; the rootlets of the cranial nerves were more tethered within the jugular foramen. This has surgical implications as substantial tethering of these rootlets require additional dissection during surgery thereby increasing the risk of iatrogenic injury to the cranial nerves. It has also been reported that compartmentalization of the jugular foramen accentuates the clinical presentation of the glomus jugulare tumour. Thus, a knowledge of variations within the jugular foramen becomes imperative to ENT and neurosurgeons.

P3-CS95

Portal segmentation of the human liver: seven portal segments

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The knowledge derived from dissections of the hepatic portal vein in the human liver were different from that expressed in the Anatomy texts. To investigate this difference, we studied 150 necropsied livers belonging to people of both sexes, different races and ages that fluctuated from fetuses to octogenarians. The technique of acrylic injection in the hepatic portal vein and the digestion of the hepatic parenchyma with hydrochloric acid was used to obtain vascular molds. The results showed that the Porta vein reaches the hepatic hilum and divides into the right and left branches in 100% of cases. These primary branches emitted seven terminal secondary branches in a monodic form (one by one) destined to seven portal segments in 100% of cases. The left portal branch emitted the branch for segment I (posterior segment), for segment II (left lateral), for segment III (anterior left lateral) and for segment IV (left medial). The right portal branch emitted the branch for segment V (right medial segment, which encompasses the parenchyma between the right portal fissure and the main portal fissure, from the inferior border of the liver to the inferior vena cava), for segment VI (anterior right lateral) and for segment VII (posterior right lateral). The most important variation was the birth of the segmental branch V, this branch emerged from the right portal branch in 79% of cases or from the left portal branch in 21% of cases. There was no segmental branch VIII in 100% of cases. This knowledge will contribute in making precise surgical approaches and interpreting radiological images easily. This study was done in Peru, where the Ministry of Health and the Ministry of Justice allow the investigation of human organs in medical schools without requiring legal permits or ethical declaration.

P3-CS96

Razor blade and puncture needle: two forensic anatomy lessons about carotid sheath

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The accessibility of the carotid sheath is a two-edged sword: for central venous catheterisation could be routinely punctured, nevertheless, it could be also intentionally easily damaged. Basic questions of medico-legal autopsies are whether the injury was inflicted by the decedent, whether it is an ante-mortem one, and whether it is related to cause of death at all. We would like to present two different autopsy cases to highlight the importance of carotid sheath topography in forensic setting.

48-year-old male committed suicide by cutting the left side of his neck with blades of a disposable razor. On external examination, the large (9.5x4.0 cm) laceration injury consisted of at least 6-7 hesitation marks with cuts of variable depths. The cut injury of the platysma, investing cervical fascia, external jugular vein, carotid sheath, internal jugular vein, vagal nerve was found, with the preservation of common carotid artery. The direction, depth and side patterns of

the complex injury helped us to rule out the manner of death as suicide.
65-year-old female with metastatic malignancy (primary tumour site lung or pancreas, contested) was subjected to central venous catheterisation to provide entry port for parenteral nutrition. During the procedure, the common carotid artery was mistakenly punctured instead of internal jugular vein. The puncture site compression attempt for controlling the carotid bleeding led to reflectory cessation of heart function.
The unaided (i.e. without ultrasound), re-attempted, emergency and left-sided jugular punctures have the highest literature failure data (up to 19% of all cases!). Procedures even carried out according to guidelines still have an in-built risk for failure, subjected to potential medical liability suits.
The scientific and educational use of anonymised data from medico-legal autopsies is permitted by the Hungarian Health Act No. 154/1997, by the Government Decree No. 351/2013 and by the faculty ethical permission for our department.

P3-CS97

A morphological and morphometric study of the Jugular Tubercle in a Greek Population

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The jugular tubercle (JT) is an essential anatomical landmark of the skull base surgery, as its removal creates a better visualization of the lower clivus' structures.
The current study highlights the morphological and morphometric anatomy of the JT and shape and size variants, as well as the distances JT from the hypoglossal canal (HC) and occipital condyle (OC).
Methods: Fifty dry Greek skulls (100 sides) from the osseous collection of our Department were measured using a digital caliper. The JT length, width, and thickness were calculated, as well as the distances JT-intracranial orifice of the HC and JT-OC. The JT shape was evaluated and classified into 6 categories (1-flat, 2-low circular, 3-large ovoid, 4-sharp, 5-pin point, and 6-double protuberance).
Results The majority of the skulls (36%) had a JT of low circular protuberance at the right (R) and 26% at the left side (L) and large ovoid protuberance at the L (38%). A sharp JT was detected in 20% at the R and in 10% at the L. A JT of double protuberance was found in 6% at the R and in 2% at the L. Side asymmetry existed concerning the JT shape. The JT length, width, and thickness were 14.44±2.40mm, 9.43±1.59mm and 9.48±1.37mm at the R and 14.37±2.72mm, 9.91±1.49mm and 9.47±1.89mm at the L and side symmetry was found. The distance JT–HC was 8.92±1.50mm at the R and 8.81±1.55mm at the L and the distance JT-OC was 23.81±3.28mm at the R and 23.03±2.13mm at the L.
Conclusion The basic far - lateral approach is used to excise lesions located medially to the lower clivus and includes JT drilling. Knowledge of the anatomy of the JT, its variations and distance from nearby important landmarks is crucial to remove completely lesions without injuring the glossopharyngeal, vagus, accessory and hypoglossal nerves.

P3-CS98

A systematic review of the aortic arch branching pattern variants. Their clinical impact

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The typical branching pattern of the aortic arch (AA) consists of three main branches from right to left; the brachiocephalic trunk (BCT) followed by the left common carotid artery (LCCA) and the left subclavian artery (LSCA). Differences among the AA branching patterns arise from alterations in the development of the embryologic pharyngeal arch arteries during the gestational period.

The current systematic review highlights the prevalence data of the AA variants and provides the incidence of the most common and uncommon types. Moreover, it classifies all detected variants in types and underlines their clinical impact.

A systematic search of the electronic databases PubMed, Embase, Scopus, ScienceDirect, Web of Science and SciELO was performed for detecting the incidence of AA variants. Studies including prevalence data on cadavers were collected and analyzed.

A total of 20 articles were included (N = 4610 arches). The typical branching pattern was detected in 3502 cadavers (76%), while the AA branching pattern variants were detected in 1086 cadavers (23.6%). The origin of the LCCA from the BCT was detected in 625 cases (13.6%), the left vertebral artery variant origin from the AA was detected in 184 cases (4%) and the common origin BCT and LCCA was found in 159 cases (3.45%). The aberrant right subclavian artery (ARSCA) was detected in 40 cases (0.87%), the bi-BCT in 25 cases (0.54%), a thyroidea ima artery originating from the AA in 13 cases (0.28%), while the other variants were less than 0.67%.

Although patients with AA variants are often asymptomatic, they constitute a significant part of the population and pose a high risk of hemorrhage and ischemia during thoracic surgery. Because of the possibility of encountering such variants, surgeons should consider potential variations when planning endovascular procedures in the thorax.

P3-CS99

Aortic arch variants with clinical impact on the trachea

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Typically, the aortic arch (AA) gives origin to the brachiocephalic trunk (BCT), the left common carotid artery (LCCA) and left subclavian artery (LSCA).

The current cadaveric study highlights characteristic cases of AA variants found after cadaveric dissection and underlines their impact on trachea. Coexisted neurovascular aberrations are also recorded.

The AA variants causing tracheal compression are described in 8 Greek donated cadavers (mean age, 76 years) after written informed consent.

The aberrant right subclavian artery (ARSCA) is the commonest AA variation (incidence 2.3% in Greeks). A course of the ectopic vessel between trachea and esophagus was found in 1 case, which coexisted with a bicarotid trunk (BiCT), while no pretracheal course was found. Another case of BiCT was detected in coexistence with a Kommerell diverticulum and an ARSCA. An atypical common origin of the LCCA with the BCT from the AA (1 case), a common trunk of the LCCA and BCT from the AA (1 case) and an atypical origin of the LCCA from the BCT (1 case) were also detected. In addition an ectopic (leftward) origin of the BCT with trachea compression and displacement at the right side was recorded in 3 cases. In such cases, the ectopic vessel was elongated.

The knowledge of AA variants that may compress on trachea is of paramount importance for clinical purposes. During tracheotomy, thyroidecomy and surgical neck dissection, the lack of knowledge of these variants may cause massive hemorrhage.

Thus, preoperative diagnosis, based on imaging, is essential.

P3-CS100

Anatomical variation of the piriformis muscle and sciatic nerve in a South African cadaver cohort.

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The sciatic nerve is unique because of its extensive course throughout the gluteal region, and lower limbs. This intricately long course makes the nerve vulnerable to injury from various medical causes. This nerve, and its branches, are the most frequently injured nerves within the human body. Another reason for injury could be related to an inadequate knowledge regarding anatomical variation of the nerve. The aim of the study is to describe and document the anatomical variation of piriformis morphology in relation to the sciatic nerve bifurcation within a South African population. Additionally, to assess the level of bifurcation of the sciatic nerve within the lower limbs of the study sample, especially where this bifurcation influences the morphology of the piriformis muscle. South African lower limb specimens (N=340) were acquired for the present study. Specimens were distributed over three South African subpopulation groups, namely, White/Caucasian (n=232), Mixed race (n=78) and South African Black (n=30). Once gluteal dissection was completed, the piriformis morphology was described and categorised in relation to the course of the sciatic nerve. Ethical approval was obtained from Stellenbosch University's Health Research Ethics Committee, complying with the South African National Health Act. In all instances where cadavers were used, anonymity was maintained. Analysis of the relationship between piriformis, and the sciatic nerve, resulted in 43 (12.65%) specimens that presented variation in the muscle's morphology. Additionally, 297 (87.35%) specimens presented "normal" anatomical features. The most prevalent variation was type B (10.59%), where the common fibular division of the sciatic nerve pierced piriformis as it coursed through the gluteal region, dividing the muscle into two separate bellies in. While this is the largest known study of its kind on the African continent, further studies are needed in order to confidently reveal trends about variation prevalence in a South African population

P3-EA2

Attitudes to the Whole Body Donation in Students of University of Novi Sad, Serbia

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Serbia is one of the countries where the number of whole body donations is relatively low and where lack of cadavers for anatomical study is felt to a considerable degree. The aim of this study was to investigate attitudes of students from the University of Novi Sad towards the whole body donation. A survey was carried on a sample of 1602 students of University of Novi Sad (average age: 20.44±2.25y). Sample included students of the Faculty of Medicine, Faculty of Technology, Faculty of Philosophy and Faculty of Sciences. Ethical approval was obtained from the Ethical committee of the Faculty of Medicine and the responsible authorities of other faculties. Only 21.9% of students supported donation of their own bodies, and 21.55% supported donation of bodies of their family members. Unlike body donation more students supported organ donation (45.68% supported donation of their own organs, and 41.13% supported donation of organs of their family members). Study program significantly influenced on the attitude towards whole body donation - psychology students had most positive attitude (27.87%), while medical students showed less willingness to donate bodies (19.51%). The most common reasons for self-body donation were the wish to help medical research, and to help others, while the most

frequent answer against body donation was insufficient information. Results of this study highlight the importance of informing students about body donation in devising more efficient donation strategies.

P3-ED1

Effects of Prenatal Nicotine Exposure on the Dental Development of Long Evans Rats (Rattus norvegicus)

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The purpose of this study was to investigate the dose-dependent effect of prenatal nicotine exposure on dental development in humans, using rats (Rattus norvegicus) as an animal model. The study sought to answer two questions: i) does prenatal exposure to nicotine have negative effects on dental development in offspring? ii) are the negative effects long lasting?
Cigarette smoking is extremely common among pregnant women and youth. However the dose dependent effect of prenatal nicotine exposure on dental development has not been thoroughly investigated.
All procedures used on live animals were approved by St. Olaf College Institutional Animal Care and Use Committee. Twelve female and six male Long Evans rats were purchased and bred. The 12 females were randomly assigned into 4 groups of 3: Control group (no treatment), and Low (1mg/kg), Medium (2mg/kg), High (4mg/kg) nicotine dose groups. Nicotine was injected subcutaneously daily during pregnancy. Pups were raised under normal laboratory conditions.
For incisor growth measurement, offspring were anesthetized with a 2L/m oxygen flow with 5% isoflurane. Grooves were made above the gum line of mandibular incisors using an electronic dremel. After 7 days, incisor length measurement was made by measuring the distance between the gum tissue boundary and the groove. A new groove was made at the gum line. Measurements were taken every 7 days for eight weeks. Upon completion of the study, the animals were euthanized by carbon dioxide inhalation followed by bilateral thoracotomy.
Nicotine injection during pregnancy was associated with reduced food intake and weight growth of the mothers. Prenatal exposure to nicotine also altered incisor growth rates among their offspring. Our initial results show a dose-dependent effect of nicotine on dental development. Compared to control offspring, there was a decreasing trend in incisor growth rate with increasing nicotine dose for both male and female offspring.

P3-ED2

Math6 affects cellular reprogramming, pluripotency and early cell fate decisions in the mouse

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The basic helix-loop-helix transcription factor Math6 (Atonal homolog 8; Atoh8; Hath6) is critically involved in cellular processes during embryonic development of several model organisms, as well as in metabolism and tumorigenesis in humans. Especially regarding the role of Math6/Atoh8 during development, conflicting reports are found in the literature. We generated Math6 mouse mutants to gain insight into the molecular and cellular mechanisms of Math6 function in such diverse processes as development and tumor formation. Here, we report on the effect of Math6 deficiency in cellular reprogramming from mouse fibroblasts to iPSCs using Oct4, Sox2, Klf4, cMyc. Reprogramming on feeder cells is strongly

compromised in mutant fibroblasts in comparison to wildtype fibroblasts of the mouse. The critical cellular event affected from the absence of Math6 during reprogramming is the failure of mutant fibroblasts to undergo mesenchymal-to-epithelial transition, accompanied by the downregulation of epithelial markers and upregulation of mesenchymal markers. In mutant murine ESC lines from our knockout mice as well as in mutant iPSCs, we observed that the loss of Math6 also influences the maintenance of pluripotency and early fate decisions during murine development. During early fate decisions, the loss of Math6 primes pluripotent stem cells towards a mesendodermal fate. Math6 can thus be considered as a regulator of reprogramming and pluripotent stem cell fate. Our results suggest the involvement of Math6 in SMAD-dependent TGF beta signaling. As commercial antibodies against Math6 protein yield poor results, we generated a Math6Flag-tag mouse and monitored Math6 protein during the processes studied. Taken together, our results suggest that Math6 is required for the initiation of cellular reprogramming as well as for the maintenance of pluripotency and early differentiation by counteracting TGF beta signaling in the mouse. All animal procedures performed in this work were in accordance with the German Animal Welfare Act.

P3-ED4

Deciphering the Triggering Mechanism of Ankylosing Spondylitis

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We study the molecular mechanisms controlling intervertebral disc remodeling and vertebral bone fusion during embryogenesis and animal development to understand disease processes in humans. Chicken is an ideal model to study both normal and pathogenic events as birds exhibit several axial skeletal regions that fuse, similar to human sacral and caudal fusion. We have discovered a role for complement and neutrophil cells in direct transdifferentiation of chondrocytes to osteoblasts in the intervertebral discs of the pygostyle in chicken - leading to remodeling and bone fusion. We hypothesize that Ankylosing Spondylitis, one of a number of diseases causing back pain in humans, is triggered when nucleus pulposus produce Complement C3 protein, recruiting neutrophils to the intervertebral discs, which in turn triggers an inflammatory response, resulting in remodeling of intervertebral discs, inflammation, pain, and pathogenic bone fusion. Ethical approval: CU AUP2011-041, MSU IACUC2015-26. No experiments were performed on living animals. Euthanasia to obtain tissue samples followed the 2013 AVMA guidelines.

P3-ED5

Quantitative morphological data of the human pituitary during embryonic development, by stages

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Pituitary cell lineages are thought to be defined from about the 6th week of embryonic development. Colocalisation of hormones has been demonstrated for growth hormone and prolactin in the normal adult human pituitary, and for other hormones in pituitary adenomas. We have previously reported colocalisation of FSH and GH in human embryo-foetal pituitaries of 8-24 weeks and that clusters of such colocalizing cells occur in particular patterns.
We have now extended the study to 6-8 weeks embryos (stages 11-23), using caryometry for defining cell types of the embryonic pituitary, from DREM collection (Digitally Reproduced Embryonic Morphology, with kind permit) and other four therapeutically aborted embryos of 6–8 weeks gestational age (with ethical approval), which were processed and examined for determining the stages (st.) of development. Next, two rectangular axes of the pituitary cells nuclei were measured and the mean cell nuclear volume was calculated.

The key stages were: 11,13,17,18,19,20,23. The range of mean nuclear volume varied as follows: 93.2-106.8µ3 (st. 12-17), 120.7-160.4 µ3 (st. 18-19), 159.5-182.6µ3 (st. 20-21), 188.45-210.5µ3 (st.22-23). For st. 12-17, the distribution was symmetrical (less symmetrical to the end), and for st. 19-23 it was bimodal, showing a variety of sizes defining (once the two buds fuse) at least two populations of cells.
These data show that this classical method is not old-fashion, but it can provide good information on the morpho-functional correlations of the pituitary cell lineages differentiation, during ontogeny. They help understanding aspects of histogenesis during pituitary ontogenesis, as stages are mostly based on organogenetic facts. We also collected these data as another approach to sustain the hypothesis that the potential for coexpression of a gonadotrophin with growth hormone and/or prolactin is preserved and can be reactivated in adulthood during tumoral transformation, perhaps from progenitor cells, as two populations can be well-distinguished here.

P3-ED7

CNP1-cre: P110a fl/fl mouse shows high levels of FGF21 levels and low bodyweight

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CNP1-cre mouse has been widely used in neuroscience research as CNP1 is exclusively expressed in myelin. We are reporting that CNP1-cre: P110a fl/fl mouse has a low bodyweight phenotype. After carefully study, we believe that this phenotype is not caused by any neural disturbance. CNP2 protein shares the same locus as CNP1 with only 20 extra aa coding sequence in the 5' end, so the CNP1-cre: P110a fl/fl mouse lose P110a in CNP2+ cell as well. We found that CNP1-cre: P110a fl/fl mouse has high levels of FGF21 in the serum and low levels of blood sugar. CNP2 shows high expression in the liver. Further study revealed that CNP1-cre: P110a fl/fl mouse has high expression levels of FGF21 in the liver and abnormal metabolisms of lipid and sugar. We concluded that high levels of FGF21 may be the cause of low bodyweight of CNP1-cre: P110a fl/fl mouse. All animal experiments were approved by the Institutional Animal Care and Use Committee at Wuhan University.

P3-ED8

Fate of gubernaculum testes revisited: a pre and post-natal human cadaveric study

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Gubernaculum testes is the most important parameter in testicular migration. At the end of migration, it is essentially a fibrous structure. Hence after birth, it is described as the scrotal ligament. There is a paucity of literature regarding the further fate of scrotal ligament. It has implications in testicular torsion and cryptorchidism. The present study aims to understand the transition of Gubernaculum to Scrotal Ligament by examining the pre and postnatal morphology of gubernaculum.
Sixteen adult cadaveric testicular specimens and fourteen fetal testicular specimens of different age groups were examined. In adult cadavers, meticulous dissection of the scrotum was done. Length of scrotal ligament if present, site of its proximal and distal attachment were noted. Tissue specimens were collected and Masson's trichrome staining was done. In the case of fetuses, dissection of abdomen and scrotum was done and the same parameters were observed.
A separate scrotal ligament could not be delineated in any adult specimens. It merged with testicular coverings. Histological examination showed the presence of patchy areas of dense regular collagen fibers amidst loose areolar connective tissue. The density of collagen fibers was highly variable. In contrast, fetal specimens showed the presence of definitive gubernaculum testes extending from lower pole of testes to scrotum. Microscopic examination revealed the presence of mesenchymal tissue, collagen, elastic

fibers and myocytes which varied according to the gestational age of fetuses.
Structure of scrotal ligament and gubernaculum testes are highly variable. Description of scrotal ligament as a firm attachment from the lower pole of testes to the scrotum is controversial questioning its role as a protective factor in testicular torsion. Further study in patients presenting with testicular torsion will provide more relevant insights.
The present study was performed after getting approval from the human ethics committee of Government medical college and hospital Chandigarh.

P3-ED10

The role of the microbiome in the development of the lateral line nerve in zebrafish

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The genetics of the development of the vertebrate central nervous system (CNS) is relatively well understood, but the role of environmental factors in this process is little studied. The microbiome has been linked to neuronal function in adults however its role in neurodevelopment has not been investigated. We hypothesised that the microbiome contributes to neural circuit assembly during development. To test this, we generated germ-free (gnotobiotic) zebrafish embryos. Gnotobiotic status was validated using a combination of microbiological and real time PCR techniques. The development of neurons was investigated by immunostaining and the embryos examined using light and confocal microscopy at 4 and 5 dpf (days post fertilisation) . A phenotype was observed in 100% of both day 4 and 5 germ-free embryos in the peripheral axons of the lateral line system. The lateral line system is a superficial sensory system found in amphibians and fish which is crucial for the detection of movement and other hydrodynamic inputs. Defective lateral line axons characteristically extended in a convoluted and irregular fashion. In addition, lateral line axons were also more intensely labelled with acetylated alpha-tubulin in the germ-free embryos. Alpha-tubulin acetylation regulates axon stability, and this could indicate a possible regulatory mechanism. This system originates from bilateral cranial placodes and involves the seeding of neuromasts along the body of the embryo, which then guide the migration of the lateral line neuron. Future work will focus on whether it is the development of the placode, the neuromasts, the axons or a combination of these which is perturbed in the germ free embryo. Together, our findings suggest that microbial communities play a key role in the assembly of neural circuits during development. This work was conducted under UK Home Office guidelines.
This work was funded by a summer studentship from the Anatomical Society

P3-ED11

Generation and Long-term Culture of Mouse Dental Epithelial Organoids

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Enamel is the hardest tissue of the body and serves as a protective surface against tooth decay. Damage to enamel is permanent in humans because ameloblasts, epithelial cells responsible for enamel deposition, are lost during tooth eruption. In mouse incisors, however, adult dental epithelial stem cells (aDESCs) exist and produce ameloblasts providing enamel to the continuously growing tooth. Here, we describe the establishment of a long-term 3-dimensional organoid culture system for aDESCs isolated from adult mice. Organoids could be established from single aDESCs and formed spheres retaining the stratified epithelial structure in the initial culture

condition. Buds reminiscent of epithelial invagination in early tooth development formed from the organoids with fibroblast growth factor 10 (Fgf10) treatment. A Notch signaling inhibitor increased basal cell number in organoids and, in combination treatment with Fgf10, induced ameloblast marker expression. Transcriptomic profiles of the organoids resembled those of pre-matured ameloblasts in mouse incisors.
All the experiments were performed according to the guidelines of the Yonsei University College of Dentistry, Intramural Animal Use and Care Committee. This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (NRF-2019R1A2C3005294 and NRF-2016R1A5A2008630).

P3-ED14

Establishing a culture system for the in vitro study of pineal organ development in the chick embryo

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The pineal organ is a neuroendocrine gland that regulates circadian and circannual rhythms as well as sexual maturity through the cyclical production of melatonin. In non-mammalian vertebrates, the pineal organ is directly activated by ambient light, and its principal cells (pinealocytes) strongly resemble retinal photoreceptors, leading to the suggestion that the mammalian pineal organ is a vestigial 'third eye'. Although the neuroendocrine and evolutionary roles of the pineal organ have attracted intense interest from researchers, surprisingly little is known about the earliest steps of its development.
The pineal organ forms as a small outpocketing of the roof of the posterior forebrain, the diencephalon. Signalling factors of the Wnt and Fibroblast Growth Factor (FGF) families have been implicated in positioning the pineal progenitor domain, and these and other signals continue to be expressed in the diencephalic roof suggesting that they play an ongoing role in the cellular proliferation, differentiation and/or morphogenesis of this region. However, to specifically test these roles in vivo is difficult because of the time-sensitive and pleiotropic actions of each of these signalling pathways.
Here we describe a chick tissue culture system that recapitulates pinealogenesis in vitro allowing us to assess the effects of specific factors on pineal organ development ex vivo. A comparison of different culture conditions and media revealed that culturing neural forebrain roof explants on hydrophilic PTFE membranes floating on Ham's F12 medium supplemented with 5% fetal calf serum led to robust induction of the pineal progenitor marker NOT1 in 71% of explants. Preliminary experiments indicate that addition of either dorsomorphin (pharmacological inhibitor of Bone Morphogenetic Protein signalling) or SU5402 (inhibitor of FGF signalling) resulted in a significant reduction of NOT1 expression, suggesting that both pathways are required for pineal differentiation at the developmental stage tested in our experiments.

P3-ED15

Creation of an E-Tutorial to Support Learning Embryology

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Digital technologies are increasingly becoming part of our daily routine. Indeed, these also have become adopted into the educational setting, including that of anatomy, and provide a useful adjunct alongside traditional teaching methodologies. This project uses a co-creation approach to improve student engagement with course materials, empowering them to be involved in designing subject specific resources. By using industry standard software (Articulate 360) a fully interactive, visually engaging e-tutorial was created based around the intended learning outcomes of the embryology teaching undertaken within the third (junior) year of the BSc Honours Anatomy degree at the University of Glasgow. The areas that the e-tutorial creation centred around were fertilisation, implantation,

differentiation, gastrulation, neurogenesis, somitogenesis and organogenesis.
In addition to this, we used Easy Paint Tool Sai to draw individualised simple cartoon like diagrams to improve and simplify understanding of complex embryological processes during the first four weeks of development. Informal feedback was gained from peers by user testing, and was reviewed by a specialist in embryology teaching and research with pointers given for improvement. This feedback was applied to improve the functionality of the tutorial. By enabling the student to collaboratively develop resources has been shown to improve higher order cognitive engagement and loading, thus improving understanding of the subject area, in this case embryology. This project demonstrates how to involve the student in creating subject and curriculum specific digital tutorials and the processes surrounding this.

P3-ED17

Migratory behavior of coronary endothelial strands in three-dimensional collagen gel culture of avian embryonic heart outflow tract

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During the coronary artery stem formation, endothelial strands from peritruncal ring (PR, endothelial progenitor cells surrounding conotruncus) invade into the aortic root to form the coronary artery stems at proper sites. Vascular endothelial growth factors (VEGFs) as well as CXCL12/CXCR4 signaling are required to form coronary vessels. To date, mechanisms regulating the endothelial strands exclusively penetrate into the aortic root remain an open question. Three-dimensional culture model of coronary artery endothelial stem (coronary stem culture), in which stage 28/29 avian embryonic outflow tract containing PR was cultured in collagen gel lattice, was established. In this culture, endothelial strands preferentially migrated into the aortic area, indicating that the culture model mimicked the process of coronary artery stem formation in vivo. AMD3100, CXCR4 antagonist, affected the preferential invasion of the endothelial strands into aorta, and CXCL12-soaked beads attracted the endothelial strands from the PR in culture. Sema3a inhibited the formation of endothelial strands and inhibition of Sema3a activity induced the invasion of endothelial strands into the pulmonary trunk area. Although, Sema3a was expressed in PR before the formation of endothelial strands, the expression of Sema3a was downregulated in certain regions, into which coronary endothelial strands were invading. CXCR4 was expressed in the endothelial strands penetrating into aorta and Cxcl12 was in the aortic wall. Our three-dimensional coronary stem culture is useful to investigate the mechanisms regulating the formation of the coronary vessels from the PR. Spatiotemporally regulated VEGF activity by Sema3a in association with CXCL12-CXCR4 signaling may play a role in the formation of coronary artery stems at proper sites. In our experiments, embryos used were under E8. Incubated eggs were placed on ice and the embryos were extirpated after cardiac arrest. Animal handling and procedures were approved by the Osaka City University Animal Care and Use committee.

P3-ED18

Restoration process of two cardiomyocyte injury models in early chick embryonic heart

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Adult mammalian heart is non-regenerative because cardiomyocytes do not re-enter the cell cycle after injury. In contrast, urodele amphibians and teleost fishes retain a capacity for cardiac regeneration by dedifferentiation and proliferation of preexisting cardiomyocytes. To date, only a few literatures have been published

on the embryonic heart regeneration, so that it is uncertain whether the heart is capable of regenerating before the formation of epicardium. The purpose of this study is to establish the cardiomyocyte injury models in early chick embryonic heart and examine the restoration process after heart injury. Heart apex was injured by a cryoprobe (cryoinjury model) or cut by a microdissecting tool (incision model) at HH stage 16. Embryos were reincubated, and the restoration process of the injured site was examined. Immediately after cryoinjury, cardiomyocyte defect was closed by endocardium herniated through the defect followed by the formation of scar tissue containing epicardium, mesenchymal cells and blood cells. Five hours after cryoinjury, cardiomyocytes surrounding the defect showed a reduced BrdU incorporation and an up-regulation of Cdk inhibitor protein p27 suggesting that G1-S arrest occurred at the acute phase after cryoinjury. In the incision model, BrdU incorporation into the remaining cardiomyocytes was not affected. There was no cardiomyocyte progenitor cells in either the scar tissue or remaining cardiomyocytes in the both models. These observations suggested that neither the dedifferentiation nor reactive proliferation occurred in the remaining cardiomyocytes after the injury before the formation of epicardium. In our experiments, embryos used were under HH stage 29. Incubated eggs were placed on ice and the procedures for heart injury were performed after transient cardiac arrest. Animal handling and procedures were approved by the Osaka City University Animal Care and Use Committee.

P3-ED19

Ossification and morphogenesis of vertebra in Japanese newt, Cynops pyrrhogaster

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The vertebra consists of centrum, intervertebral disc, and vertebral arch. Both the centrum and intervertebral disc are formed based on the notochord composed of notochordal cells and notochordal sheath surrounding these cells. In most tetrapods including anuran amphibia, the centrum is formed externally to the notochordal sheath (perichordal ossification). In fish, on the other hand, it is formed within the notochordal sheath. Morphogenesis of vertebra in urodelan amphibia has not been understood well. This study was addressed the ossification and morphogenesis of the vertebra in the Japanese newt, Cynops pyrrhogaster.

Stages 30, 41, 51, 57, 59, and 60 embryos were anesthetized with MS-222, pre-fixed with Karnovsky fixative under microwave irradiation, and then post-fixed with osmium tetroxide, dehydrated with ethanol and propylene oxide, then embedded in Epon812. For making 3D-reconstruction images, about 1,000 serial semithin sections (1 μm thickness each) were cut, stained with toluidine blue, taken photographed, and all images were aligned with ImageJ. 3D-reconstruction were made with Expert INTAGE (Cybernet Co.). Cartilage formation and ossification were identified with Alcian blue staining, polarized microscopy and electron microscopy.

In stage 51 embryos, three-layered notochordal sheath was clearly observed. Mesenchymal cells were aggregated around the neural tube. The ossification was not observed in this stage. In stage 59 embryos, the cartilage was formed around the neural tube. Around the notochord, on the other hand, the cartilage was periodically formed along the anterior-posterior axis. The ossification was identified at the outermost area of the notochordal sheath along entire region of the notochord. These data suggest that the Japanese newt vertebra is formed by 2 different types of direct ossification (perichondral ossification and perichordal ossification).

All experiments were approved by the Experimental Animal Ethical Committee of Kitasato University.

P3-ED20

The role of Sox2 in neuromesodermal progenitors and neural specification in the mouse

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Neural tube and somites have long been thought to derive from distinct germ layers, namely the ectoderm and mesoderm. This paradigm was challenged by the discovery of neuromesodermal progenitors (NMPs), a bi-potent cell population that gives rise to both spinal neural tube and somites, beyond the gastrulation stage. In accordance with their dual-fate, these cells have been thought to co-express the neural marker Sox2 and the mesodermal marker T/Brachyury. However, unlike for T, expression or requirement of Sox2 in NMPs has not been convincingly demonstrated. Therefore, we sought to characterize the potential role of Sox2 in NMPs of the mouse embryo. We evaluated the expression of T and Sox2 in NMPs by means of in situ hybridization and immunohistochemistry in the tail bud region where NMPs reside, as well as by genetically tracing the lineage of T- and Sox2-expressing cells. Furthermore, we conditionally deleted Sox2 in T-expressing cells and studied how development proceeds in its absence. Our findings support a model where Sox2 is expressed exclusively downstream of neural commitment but is not required for the formation of the neural tube.

Mouse studies were conducted under the auspices of the UK Animals (Scientific Procedures) Act 1986, as described in Project Licences 70-7469 and P8B3094F0 which were scrutinised and approved by the Animal Welfare and Ethical Review Body of University College London.

P3-ED21

Dysmorphology In Non-Syndromic Autism Spectrum Disorders

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Excessive Minor Physical Anomalies have been reported in subjects with autism as compared to healthy individuals. The aim of the current study was comparison of MPAs in subjects with ASD in mild to moderate and severe cases.

Forty one subjects with ASD were recruited from Children's Hospital Lahore with a confirmed clinical diagnosis by Developmental pediatrician, using DSM-V. An informed consent was taken from parents. They were categorized into two groups depending on the severity of symptoms using Childhood Autism Rating Scale; Group A (mild to moderate) and Group B (severe). Physical measurements including height, weight, head circumference, length of outer and inner canthi, ear, hand, finger and foot length were recorded and were compared with standard charts. Autism Dysmorphology Measure work sheet, based on physical examination of 12 body regions was used to label the subjects with dysmorphology in 6 or more regions as Dysmorphic otherwise as Non-dysmorphic.

There were 30 (73.2%) subjects in Group A and 11 (26.8%) in Group B with male: female ratio 5:1 and 4.5:1 respectively. Mean (± SD) age of patients was 72.32 (± 33.31) months. Out of 30 in Group A, 12 (40%) were dysmorphic whereas only one (9%) in Group B was dysmorphic. Microcephaly was noticed in 7 (23.3%) and only 1 case (9%) in Groups A & B respectively. Excessive dysmorphic feature were observed in Group A but there was no statistically significant difference between two groups. In descending order of frequency, the affected regions were ears, feet, mouth/ lips, teeth, face, fingers/ thumb, philtrum, hair growth pattern, eyes and hands.

This is an ongoing study, to report on more subjects with genetic analysis in a trio based model.

The study was approved by Ethical Review Committee of University of Health Sciences and Institutional Review Board of Children's Hospital.

P3-ED22

Morphometric Study of Human Foetal Heart at different gestational ages

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The study includes dimensions of atrial, ventricular and interventricular septum including the weight and volume of the human foetal hearts from 7th - 40th weeks of gestational age and to co-relate it with other studies.

This cross-sectional study was done on 30 human foetuses of varied gestational age from 7th - 40th weeks received in the Department of Anatomy, Government Medical College & Hospital-32 Chandigarh after getting clearance from institutional ethical committee. Crown rump length, head circumference and weight of the foetus were taken. After meticulously dissecting the heart, volume and weight of the heart as well as the wall thickness of left ventricle, right ventricle and interventricular septum were measured. The measurements were taken from the thickest part of the corresponding wall after sectioning it coronally from the apex below, to the transverse pericardial sinus above. Data was tabulated, calculated and analysed statistically. The heart weight increased by 389.35 folds from 0.104 to 40.493 gms, volume increased by 32 folds from 0.25 to 8 cc from gestational age 7 -40 weeks. There is a strong trend ($p< 0.001$) noted in the increased thickness of left ventricle, right ventricle and interventricular septum. It increased by 7.65 folds upto 21 weeks and then started decreasing by 3.97 times from 21 weeks to 40 weeks. Similarly in right ventricle, it is 7.41 folds upto 21 weeks and then starts decreasing by 1.64 folds till 40 weeks. The interventricular septum thickness increased 9.85 folds upto 20 weeks then started decreasing 1.88 folds till 40 weeks of gestational age.

Present study is more authentic then echocardiographic ones for measuring the parameters of human foetal heart. The study also emphasises the increase in the parameters of the heart with the gestational age, crown rump length and head circumference which will be definitely helpful to cardiologists.

P3-ED23

Five-Day Time-Lapse Analysis of in vivo Mouse Embryos during Vaping Condensate Exposure

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The marketing of electronic nicotine delivery systems (ECIGs), that create inhaled aerosols for pregnancy's morning sickness in place of traditional tobacco cigarettes is concerning.[1] Little is known about effects of ECIG aerosol mixtures on a developing embryo.[2] Our research addresses ECIG carrier fluid (CF) and nicotine on embryonic development to reduce misconceptions about vaping.

Vapor condensate of CF purchased without a flavor additive, with and without 1.2% nicotine in the unvaped fluid, was collected from a glass-bead-filled, copper coil, submerged in ice. Recovered condensate CF with and without nicotine, was diluted to 0.01, 0.1 and 1%, in M16 media for culturing 2-cell mouse embryos for 120hrs in 5%-CO2/100% H2O/air in a Keyence® time-lapse culturing microscope.

Female B6CBAF1/J mice were superovulated/mated with CD-1 males. Post-mate, plug-positive females were euthanized (cervical dislocation), fallopian tubes collected and irrigated. Two-cell embryos were randomly collected and individually placed in 96-well plates containing M16 alone as control. CF, without nicotine was diluted to 0.01, 0.1 and 1%, in M16. CF, with the purchased nicotine at 1.2% was also diluted to 0.01, 0.1, and 1%, in M16. Plates were

incubated and photographed at 10 min intervals for 120 hrs of continuous exposure.
Both CF alone and CF with nicotine, at 0.1 and 1.0%, had significantly different blastocyst hatching ($p \leq 0.01$ and 0.001 respectively) and blastocyst morphology was significantly different ($p \leq 0.001$) for all experimental groups in comparison to M16 control embryos. Video recording at the 10 min intervals showed slower progression in development along the course of 2-cell to 4-cell to 8-cell to compacted morula and final blastula formation.
Research was funded by LUCOM Research Center and approved by the IACUC, under protocol #41.180615.

P3-ED24

The morphological analysis of the developmental process of human fetal brain

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The morphology of the embryonic and fetal central nervous system changes significantly throughout the development process. The aim of this study was to analyze the morphological changes of developing human brains using three-dimensional (3D) models reconstructed from formalin-fixed embryo and fetus specimens. At the Congenital Anomaly Research Center, Kyoto University Graduate School of Medicine, over 45,000 human embryo and fetus specimens are stored as the Kyoto Collection. Human fetal specimens of between 7 and 24 weeks gestational age with normal external appearance were selected for inclusion in this study. Data were obtained using 2.34–Tesla (T), 3–T, and 7–T magnetic resonance imaging (MRI). First, 3D models segmented into a maximum of six regions were reconstructed, and the rate of increase for each region was measured. Next, the direction of brain expansion was analyzed using geometric morphometrics, a statistical shape analysis based on landmark coordinates. The 3D models of fetal whole brains were reconstructed semi-automatically with anisotropic diffusion filtering and machine learning; 21 landmarks were registered on these models. The direction of growth was calculated using the landmark coordinates and generalized procrustes analysis, principal component analysis, and multivariate regression. The major pattern of morphological change was significant expansion of the posterior part of the cerebral hemisphere. In addition, statistical shape models showing changes according to fetal growth were created.
These morphological analyses will aid in the detection of congenital anomalies and disease and improve understanding of encephalization.
This study was authorized by the Ethics Committee of the Graduate School of Medicine and Faculty of Medicine, Kyoto University (R0316, R0347).

P3-ED25

Postnatal growth of the zygomatic bone

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The zygomatic bone is a paired facial bone situated in the upper lateral part of the face, forming the prominence of the cheek. The goal of our research was to investigate the dynamics of zygomatic bone development and compare absolute and relative changes in zygomatic bone dimensions during postnatal development. In our research, we used 228 bones (age range 0-30 y) from the skull bones collection at the Institute of Anatomy “Drago Perović”. To describe growth of the zygomatic bone after birth, we measured six different parametres: the height and the width of the bone, distances between lateral angle at temporal process/medial angle and inferior angle and dimensions of orbital surface. To describe relative changes in zygomatic bone dimensions we introduced growth index which was defined as

average value at adult age/average value at birth. Growth of the zygomatic bone was highest during the first year of life. Total postnatal increase in the height and width was 27,6 mm and 24 mm, respectively. Although the changes were similar, growth index of height (2,46) was notably higher than growth index of width (1,9). Growth index for distance between lateral and inferior (2,31) angle was higher than for the distance between medial and inferior angle (2,02). Increase of observed orbital dimensions ranged between 8 and 13,4 mm while growth indexes ranged between 1,7 and 1,76. The highest increase was observed in bone height, both absolutely and relatively. Comparison of growth indexes of observed zygomatic bone dimensions suggests that the zygomatic bone grows more in vertical and lateral than in medial direction.

Research was conducted in accordance with ethical standards and protocols of University of Zagreb, School of Medicine

P3-HA1

Auzoux and the factory of anatomical models of the nineteenth century, the documentary

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In 1846, a papier-mâché statue arrived in Chile from the L.T.J. Auzoux factory, France, for the study of anatomy. Since 1822, the manufacture of these skinless models (L Écorche) had begun, representing human, insect and vegetable models, being exported to many countries in the world.

In 2018 one of the authors visited the L'Écorché Museum of Anatomy in Neubourg, France. Find a film made in 1951, unknown until then by many anatomists.

This film of 15 minutes, in 16 mm, in black / white and color was realized, advised and dramatized by amateurs and professionals from Normandy, like Auzoux.

It mentions to "Bouvard and Pecuchet", (protagonists of a novel by Flaubert) who show interest in the anatomy of the Auzoux models. This serves as an excuse for the beginning of the script of this movie.

Dependencies, tools, artisans, pasta and the technique used in the models of the Auzoux factory in Saint Aubin d'Ecrosville appear, describing the different stages of its manufacture: as "the cardboard", "the terraje", "the adjustment "

The aim of this work is to disseminate it and make it known to future generations. Translation is done from French to English and then to other languages such as Portuguese, Spanish, and Turkish. In a second stage it will be expanded to other languages.

The texts are reviewed by known anatomists, in order to value this work. Then the film is edited by placing the texts on the screen, making links or QR codes for each language and disseminating them through the web pages.

This film shows the mixture between literature, art and the anatomy of the Normandy region, its influence expanded to the rest of the world in the nineteenth century, constituting a visual document that every anatomist and student should know.

P3-HA4

"De Structura Renum" by Alexander Schumlansky as a Ukrainian cultural and scientific object of the Age of Enlightenment

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Alexander Schumlansky (1748-1795) was a Ukrainian medical doctor in the Russian Empire, best known for his research in renal microscopic anatomy. His treatise "De Structura Renum" ("About Renal Structure") (1782), initially a doctoral thesis at the Strasbourg University, is the event in world history of medicine. Some

considerations allow us to appreciate it retrospectively as an integral part of the Enlightenment in Ukrainian cultural discourse.
On the title page, Schumlansky calls himself "Poltawo-Russus." We assume he saw it more as ethnonym meaning a native of the Ukrainian lands along the Dnieper.
Schumlansky primarily graduated from the Kiev Mohyla Academy, the only academy in the Left-bank Ukraine until 1805. It was there he obtained strong humanitarian background and fluent Greek/Latin proficiency.
As a student in Alsace, Schumlansky invented a method of investigation of vascular and canalicular systems in kidney preparations by injection into them solutions of resin or gamboge pigment with further microscopy. He found those two systems as spatially separated from one another, thus forseeing an existence of distinct excretory structure inside a kidney corpuscle. The structure was investigated 60 years later by William Bowman armoured with a higher magnification microscope. Bowman himself highly appreciated Schumlansky who "has even given an ideal diagram of this connection, which shows that he had a very clear conception of the fact." Therefore, we agree with the Russian/Ukrainian authors designating capsula glomeruli as "Schumlansky-Bowman's capsule."
In his treatise Schumlansky gave a description of other parts of nephron including its thin recurrent loop. The latter was studied by Jakob von Henle only in 1862. Thus, the eponym would also better look like "Schumlansky-Henle loop."
"De Structura Renum" had quickly become popular. In 1788, Johann Mayer in his fundamental anatomical work wrote that Schumlansky gave "probably the most precise" illustrative microscopic picture of kidneys.

P3-HA5

The Book of LE CAT, "Traité des Sens" (= Treatise of the senses), Published in 1740, in Rouen (France)

Patrice Le Floch-Prigent[1], Juliette Nguyen[2], Jean-Bernard Gillot[3]

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The book of LE CAT (1740) contained 16 anatomical and optical plates with 3 double ones: the sketch and explanations on one side and the print on the other one. The engravings were made by Herisset. It is the rare, first edition about the five senses, particularly the vision's one. The book was an in octavo and contained 301 pages. There was a dedication to the Lords of the Normandy's Parliament. In fact it was only one part of a large book in three volumes which will be edited later, in 1767 as "Oeuvres physiologiques, Traité des sensations et des passions en général, des sens en particulier" (= Physiological works, Treatise of the sensations and of the passions in general, and of the senses in particular (Paris, by Vallat-La-Chapelle). Claude-Nicolas LE CAT (1700-1768) founded the Royal Academy of Rouen and was one of the most famous french surgeon in the 18th century. He establishes his activity in the town of Rouen (a large harbour in the entrance of the Seine river) in 1729 as the surgeon of his protector: the archibishop La Vergne de Tresan, then he becames the chief surgeon of the Hotel-Dieu, in Rouen in 1731 where he built a dissection amphitheater in march 1736. This skilful lithotomist (ablation of the bladder stones) was a member of several societies (Academies of Paris, London, Madrid,...). We specially analyzed the anatomical accuracy of the plates..

P3-HA6

Valsalva: "de aure humane tractatus..." 1707, Utrecht: The second edition of the seminal treatise on the structure of the ear

Patrice Le Floch-Prigent[1]

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The scientific bookstore Alain Brieux (Paris, 48 rue Jacob) owned in 2018, the second edition of the

famous treatise of Antonio Maria VALSALVA. Its complete title was "De aure humana tractatus, in quo integra auris fabrica, multis novis inventis and iconismis illustrat, describitur...; quibus interposita est musculorum uvulae, atque pharyngis nova descriptio, et delineatio". It was published for this edition in Utrecht by vande Water in 1707. It was an in quarto of 143 pages with ten plates of illustrations, engraved by H. Lenting. This book described with a great accuracy the structures of the three parts of the ear, and the muscles of the external ear. The two parts of the cochlea were described (vestibular and tympanic one). The eponymic maneuver is described and also the pathological stapedian ankylosis. Valsalva (1666-1721) from Bologna was a follower of Malpighi and a professor of Morgagni. The first edition had been printed three years previously in Bologna by Constantino Pisari.

P3-HA7

"Surgical Works" of Jacques Guillemeau: analysis of the adult anatomical part in the edition of 1649

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The modern era in human gross-anatomy began with the 1543 edition of the Vesalius': "de corporis fabrica" as his (latin) text and plates were exclusively based on his own observations. In the following decades, several famous anatomists (mostly often also surgeons) performed the descriptions of new structures and books: Massa, Vidius, Andenach, Paré, Serveto, Eustachio, Canano, Colombo, Botalo, Fallopio, Arantius, Fabricius, Platter, Varolio, Gasser, Bauhun, Riolan, Spigel, Valverde. But none of them could be compared to the afford of Vesalius. In France, Jacques Guillemeau (1549-1613) was a talented and prolific surgeon, and a follower of Ambroise Paré. He published his "Surgical Works" in french language of which the posthumous edition of 1649 was the best known (NB: its 21, adult, anatomical copper-plates were identical to the parisian, 1598 edition). We studied several samples of this edition from different institutions in Paris, using reading, pictures of the plates and comparisons, focusing on the scientific veracity of its anatomical parts. The human, adult, gross-anatomy in Guillemeau's surgical works was honorable but without originality in comparison with Vesalius' ones for the plates. The text offered a noticeable effort of concision and of classification of the structures. The anatomical drawings of Leonardo da Vinci (1412-1519), mainly performed in 1510 and 1511 when staying in Milano, would have been a revolution if they had been known in their time; however they were ignored of the scientific world during a long time as the anatomist who worked with Vinci, Marco-Antonio della Torre, professor in Pavia, died from the plague in 1511 before the publication of the co-authored book. So the modern, human, adult Gross-Anatomy remained a quite recent construction of the european 18 and 19th centuries, helpt by the then, new, histological and physiological fields.
There was no conflict of interest in this study.

P3-HA8

Identification and Preservation of the Original Japanese Expressions (Yamato-kotoba) about Human body (the upper and lower extremities)

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Due to the overwhelming influences of Chinese and Western cultures to Japan so far, many original Japanese expressions about human body have been lost, except the basic ones. In order to learn and preserve these expressions, we have started to collect them from the historical documents and interpret them from the present anatomical view point. In this presentation, we report the original Japanese expression used in the ancient period of the upper and lower extremities, and visualize them on the body map.

In 938AD, Shitagou Minamoto compiled the first Japanese encyclopedia, entitled the Wamyouruijushou, showing numerous words of all category used at that time with original Japanese pronunciation (Yamato-kotoba). Through this document, we can also learn both the formal name of human body parts, appeared in the Chinese documents and the corresponding original Japanese words with the pronunciation used at that time or before. Regarding the Wamyouruijushou as the basic reliable document, we examined the ancient names of human body, and their usage in the classical documents. Besides the Wamyouruijushou, we identified a number of old anatomical terms in the major historical documents in the Nara period (7th century), such as Kojiki, Manyoushu, Nihongi.

In this presentation, we picked up the words about the upper and lower extremities, appeared in the classical documents indicated above, and confined the points or areas which the words indicating according to each context in the documents. Then we plotted the exact points or areas of human body (the upper and lower extremities), that each word indicated, onto the simple human body map to visualize them more clearly.

It would be very significant to identify and to preserve the original Japanese anatomical terms in the period before being affected any influences from the foreign culture.

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P3-HA9

The Ma Wang Dui Texts, An Anatomical Treatise?

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A series of ancient texts were found in tomb no.3 at the Ma Wang Dui site at Changsha, Hunan Province, China. The 3 tombs belong to the Marquis of Dai, his wife and son, and were sealed in 168BC, to be opened 2,000 years later in 1973. Tomb number 3 was the resting place of Lady Dai, and the preservation of artefacts in it was extraordinary. The texts that accompanied her body covered all aspects of Chinese life, and amongst them were found the earliest records of Chinese medical practice.

The texts contain descriptions of meridians or channels, which run through the body. Each chapter starts with a description of the meridian, followed by a list of associated diseases. In Confucian times, the bodies of the dead were sacrosanct. It is therefore generally assumed that dissection of the human body did not form part of medical thought. Here we argue that the meridian descriptions found in this text are in fact descriptions of the physical body, which can only have been arrived at through cadaveric dissection.

We used a combination of 2 translations of the original text to identify possible variations in interpretation of the original Chinese, and performed dissection in accordance with the HTA (2006), to see if we could reasonably identify structures which mapped onto the descriptions given. There are 11 chapters, organised into 6 divisions, with upper and lower limb meridians in each division (11 in total- 6 lower limb, 5 upper limb).

Here we discuss the lower limb meridians only, where we found that each division reflects an easily recognisable body layer, going from superficial to deep.

This means that the Ma Wang Dui medical texts could represent the world's oldest extant anatomical atlas based on the human form.

P3-HA12

Leonardo da Vinci and the Human Aortic Arch

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Leonardo da Vinci left us 500 years ago an astonishing work concerning human anatomy.His legacy is patent among his anatomical drawings and notes.On that basis a deeper look into some of his anatomical drawings is made having in mind normal anatomy and anatomical variants of what is in our days known as the human aortic arch.When depicting the upper ramifications of

the aorta as a tronc conexion to head/neck and the upper limbs, the asymmetric pattern found in opposition to what is seen in the lower tronc conexion to the lower limbs might have surprised Leonardo.Is interesting to notice in his drawings the very accurate depiction of the normal and also some of the most frequent variants of the human aortic arch and wonder how Leonardo might have interpreted these findings. Leonardo was moved by a wonderful curiosity and inquisitive spirit characterized by the looking for patterns in nature and among different species.We may also become curious and inquisitive concerning what he may have achieved, observing his anatomical drawings, having in mind comparative anatomy and variants of the aortic arch through the spectrum of modern knowledge brought by embryology, imagiology and surgery (in health and disease).
No ethical approval was required.

P3-PA2

The earliest evidence of a Lisfranc's fracture

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Recent archaeological excavations at Manot Cave, an Early Upper Paleolithic site in the Western Galilee, Israel, recovered the well-preserved remains of a partial left foot of a young adult, including the talus, the calcaneus, the cuboid and the first, second and fifth metatarsals. The pedal remains were found close to one another in the same archeological unit, and were associated with Aurignacian artifacts, dated in the cave between 38 and 34 ka.
Our study aimed to describe the anatomy of the Manot Cave pedal bones using morphometric parameters and comparison with recent modern humans, Anatomically Modern Humans and Neanderthal foot bones was carried out to establish the population affiliation of the Manot Cave specimen. Additionally, µCT images were used to verify a suspected injury of the second metatarsal.
The shape and size of the Manot pedal bones indicated an overall modern morphology for all bones, albeit few Neanderthal-like characteristics have also been noticed. Imaging analysis confirmed the existence of a healed trauma in the second metatarsal with the plantar third of the base misaligned with the shaft and a fracture line on the lateral side. Furthermore, a bone flake on the dorsomedial side of the shaft indicated forced contact with the hallux. These features are consistent with a fracture known as Lisfranc's fracture, likely caused by an impact to the dorsum of the foot. This injury often results in ligamentous instability and collapse of the transverse and longitudinal arches, causing severe walking difficulties. Full recovery requires rest and immobility for several weeks.
As mobility was crucial to maintain the hunter-gatherer lifeway of this group, the survival of this individual indicates a supportive community at Manot Cave.

P3-PA3

What can the femur tell us about human behavior and health?

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Biomechanical analysis of the femur, i.e., diaphysis cross-sectional geometry (CSG) and femoral shape, are often used in physical anthropology to study a variety of issues with regard to human skeletal adaptation to mechanical demands (e.g., locomotor performance and the effects of subsistence strategy on behavioral patterns) as well as health and nutrition status. However, the validity of the relationship between femoral diaphysis CSG or femoral shape and muscle force have not been investigated. The aims of this study were to examine the associations between muscle cross-sectional area (CSA), a surrogate for muscle force, and femoral diaphysis CSG, along with a new geometric morphometric approach for measuring proximal femoral 3D shape.

The study included 87 individuals aged 20-60 years who underwent a CT scan of the femur prior to the study. The study was approved by the ethical committee (Helsinki approval) of Carmel Medical Center, Haifa. We measured muscle CSA of the knee flexors and extensors via Philips portal (Brilliance 64). Femoral diaphysis CSG (size, shape, and strength and rigidity) at three levels (35%, 50%, and 65%) of the shaft and proximal femoral 3-dimensional shape were measured using dedicated software. We found a significant correlation between thigh muscle CSA and femoral size, and strength and rigidity measurements. Moreover, significant correlation was found between muscle CSA and 3-dimensional shape of the proximal femur. Nevertheless, no significant correlation was found between thigh muscle CSA and femoral cross-sectional shape, nor between thigh muscle CSA and medullary cavity size.

These findings suggest that femoral CSG parameters of size and strength and rigidity as well as 3-dimensional shape of the proximal femur are indicative for loadings placed on the femur, yet they are not indicative for the type of activity or the status of health and nutrition.

P3-PA4

Morphometric analysis of the femur in an adult South African cadaveric sample

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Recent studies using geometric morphometrics have shown that estimations of demographic parameters can be made using skeletal elements previously not thought useful for such purposes.

This study used geometric morphometrics to assess femoral morphological variation in an adult South African sample, and evaluated the accuracy of sex and ancestry estimations based on this variation.

Femurs of 992 adult South African individuals (447 females, 545 males) were digitized. Data sets were rotated and scaled to a common centroid using Generalized Procrustes Analysis. Mean centroid sizes between groups were compared using parametric tests, while morphological variation was evaluated using multivariate analyses. Discriminant Function Analysis coupled with leave-one-out cross-validation tests were used to assess the reliability of sex and ancestry classifications based on this variation.

Male femora were relatively larger and presented with morphological features indicative of larger muscle mass, shorter femoral necks and ante-version angles than females. White and Black individuals had relatively larger femora Coloured individuals, likely a reflection of both genetic and socioeconomic differences between the groups as enforced under Apartheid law. When sex and ancestry were assessed together, similar variations were detected than when either parameter was individually assessed. Classification accuracy was relatively low when sex was independently assessed (74.3%), but increased when considered in conjunction with ancestry (72.4 – 87.2%), indicating greater variation between-groups (ancestry) than within-groups. Ancestry estimation accuracies exceeded 80%, even for the highly diverse Coloured group.

These results show that femur morphological variation is present and may be used to estimate parameters, such as sex and ancestry, even in complex groups such as the Coloured sample of this study.

Ethical approval of this study fell under the auspices of the Body Donation clause of the Human Tissues Act of South Africa (Act No. 61 of 2003)

P3-PA5

Sexual Dimorphism in Human Skulls by Morphometric Analysis of Foramen Magnum and its' Morphology

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Foramen magnum is an important landmark of the skull base and is of particular interest for anthropology, anatomy, forensic medicine, and other medical field. It exhibits a remarkable sex differences next to the pelvis. The relationship between foramen magnum and the vascular and nerve components that pass through this foramen, is of great clinical importance as exposure of this region in cases of intra or extradural lesions involving foramen magnum and brain stem is a veritable challenge for neurosurgeons. The aim of the study was to measure morphometric parameters of foramen magnum to analyse sexual dimorphism in human skull and to determine the incidence of different morphological types of Foramen Magnum. The study was done on 35 dry human skulls (22 male and 13 females) in Department of Anatomy, AIIMS Jodhpur after ethical clearance from Institute Ethics Committee. Morphometric measurements of foramen magnum were taken with Digital Vernier calliper. Six standard parameters were measured. The data thus obtained was analysed by Discriminant function analysis using SPSS 16. Shape of the foramen magnum was analysed for its morphology. Males displayed larger mean values than females for all the measured variables. Based on sectioning point derived by the discriminant function, a value higher than the sectioning point was considered to be male and value below it considered to be female. The frequency of oval shape was higher in the morphological types. The dimensions of foramen magnum are helpful in medico legal cases for sex determination of unknown individual. Its' anatomical and morphological characteristics along with its variations enable surgeons to improve the surgical access conditions in cases of tumour resection, achondroplasia and cerebral herniation.

P3-PA6

Sex determination from calcaneus by discriminant function analysis

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Sex estimation is the basic step in biological identification process of skeletal remains as it decreases the possibility by 50%. It is the basis to identify the age, stature and population affinity of individual. Determination of sex from skeleton remains is based on three kind of process: molecular, morphological and use of measurements or metrical. In metric method scientist use anthropological measurements which can be repeated to validate the results.

Calcaneus bone is dense tarsal bone and is usually recovered intact. The aim of this study is to determine the sex of an individual from calcaneus bone.

In the present study a total 59 calcaneus (42 male and 17 female) of known age and sex from the Department of Anatomy, All India Institute of Medical Sciences, Jodhpur was used for the study after ethical clearance from Institute Etical Committee. Total 11 measurements were taken from each calcaneus in three dimensional groups' length, breadth and height. Measurements of calcaneus were taken by using digital Vernier calliper. All these parameters were entered in Microsoft excel sheet. The discriminant function

analysis was done by using statistical product and service solution (SPSS) software program.

All variables showed statistically significant difference between male and female. Discriminant function analysis was done for sex determination. Univariate, direct and stepwise discriminant function analysis was performed which showed accuracy of 86.4%, 98.3% and 91.5% respectively. The study concluded that the calcaneus bone has the ability to determine the sex of individual when partial skeleton is recovered. The reliable measurement for sex determination was height of calcaneus. Highest accuracy (98.3%) for sex determination was found with direct discriminant function analysis. Comparison of the equation with other study showed that the equations develop in this study is population specific and should be limited to use among population of Western India.

P3-PA7

Tibio-Femoral angle assessment & its Radiological co-relation in healthy Rajasthani Population

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Objective: Existence of variations in morphological proportions in human beings has led to the development of different values of tibio femoral angle (TFA) in different populations which is undoubtedly useful in clinical orthopaedic surgery. Meagre literature available among Indian population. Therefore the present study is an attempt to formulate a baseline data of Tibiofemoral angle among Rajasthani population with reasonable accuracy and also to correlate these data to radiological findings.

Material and Method: The TFA (in degrees) of 500 healthy subjects from various regions of Rajasthan were measured by using a digital goniometer in standing and supine positions to see the postural effect. In addition, the TFA of 130 persons (randomly selected) from study group were also measured in degree on roentgenogram. Subsequently both of these data were compared for co- relation to assess anthropometric baseline data in different age group.

Result: The normal range of TFA angle in Rajasthani population in between 160°-174°. TFA in standing position on right side was 170.96° with (95% Confidence Interval (CI) = 170.24 to 171.68) and on left side was 170.14° with (95% CI = 169.21 to 171.06). Mean TFA in supine position on right side in age group from 21 to 30 years was 167.12±6.73◦ and in age group from 31 to 4 0 years was 167.668±6.7◦. No significant difference was observed in posture change like in supine and standing position and according to age. Statistically significant difference was observed in between Radiological and gross measurement which was more in radiological than to clinical measurement of TFA (mean difference = +5.78units) with 95% CI for the difference is (4.03 to7.53).

Conclusion: Higher values of Tibio-femoral angle (TFA) were observed in males as compared to females and higher values in radiological measurements.

Key words: Tibiofemoral angle, Roentgenogram, Rajasthani population

P3-PA8

The study of correlations between orchidometric and somatometric parameters

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The size of testes is an important clinical indicator of fertility and the criterion for diagnosing hypogonadism and androgen deficiency. Some anthropologists have shown that fertility are clearly interrelated with the size of the genitalia, but existing data on the relationship of anthropometric indicators with orchidometric indicators are contradictory. The purpose of the study is to determine the correlation between orchidometric and somatometric parameters. The material for the study was the data of 150 men of homogeneous ethnic composition, territory of residence, social, gender characteristics and level of physical health aged 18-39 years. Instrumental

studies were carried out on the basis of the principle of ethical standards of the Helsinki Declaration (1964) with all subsequent additions and changes, the International Guidelines of CIOMS. Anthropometry was performed using standard methods, orchidometry using an ultrasound scanner. Body weight and BMI is not an indicators associated with the size of the testicle. Most of the indicators of orchidometry vary regardless of anthropometric. Only the length of the left testicle was at the level of sufficient statistical significance of correlation with the length of the trunk, but not body length. The corresponding dependences can be determined by the way of life and ethno-territorial peculiarities. Our results on the absence of interrelations between orchid and anthropometric indices body composition components determined by them, indicate that these dependences at the investigated age are obviously determined not so much by testicle size parameters as by its hormonal activity. This is also confirmed by the independent variation of the parameter of the length of the left testicle and the release of orchidometric indices into a separate cluster of variables in the multidimensional field of the studied anatomical and anthropometric characteristics. Thus, it should be considered that the unambiguous relationships between orchidometric and anthropometric parameters in men are absent.

P3-PA10

The many facets of human spinal pathology: A review of research areas and recording methodologies on skeletal remains

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Spinal arthropathies have been prevalent throughout history, so the recording and analysis of these pathologies is important across multiple disciplines from archaeology through to clinical anatomy. Analysis of manifestations of diseases and degeneration of the vertebral column in ancient human remains provides valuable insights not only into the lifestyles of past populations, but also the evolution, development and spread of spinal arthropathies seen in modern populations. To carry out research reliably on spinal pathologies in different populations requires robust and replicable methodologies. The aims of this project were therefore to identify in the literature the methods being used for identification and recording of spinal pathology on dry bone from archaeological contexts, and to explore the aims of such studies and their key findings. A review of biological anthropology and archaeology studies and professional reports identified three main methodologies. One method relates to the simple presence or absence of a condition, while two methods grade the severity of different pathological bone changes using numerical severity scales. It was also identified through the review that the overarching goal of many studies has been to compare lifestyles between populations that vary temporally and geographically. This goal seems to have been limited by several features, both in terms of the populations studied and the approaches used, which prevent direct comparisons. These need to be addressed in future analyses, while approaches such as standardisation of methods and the use of clinical knowledge in the field of biological anthropology will contribute to a better understanding of spinal arthropathies in both past and present populations.

P3-PA11

Anthropometric study of cephalic measurements and cephalic index among mon peoples of Myanmar

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Myanmar is a multi-ethnic and multi-culture country. Most of the ethnic groups of Myanmar descended from Mongoloid peoples. Mon ethnic group of Mon State in Southern part of the

country are descendants of the Mon-Khmer group within the Mongoloid peoples.

Anthropometric measurements and indices are used to describe the shape of the head and are important parameters to classify populations. This study was intended to measure some cephalic measurements and to calculate cephalic indices among the members of Mon ethnic group of Myanmar. During this study, 400 males and 270 females of Mon peoples from Chaung-Zon Township were measured. The study population was between 18 and 45 year of age and they had Mon ancestors for at least two previous generations. Results of this study were compared with cephalic measurements and indices of other ethnic groups of Myanmar by the present investigator.

According to this study, mean cephalic length of Mon peoples was 178.0 mm for males, 170.5 mm for females and 173.8 mm for both male and female combined. Mean cephalic index of them was 84.4 for males and 84.9 for females. Most of both Mon males and females were in brachycephalic and hyperbrachycephalic categories.

When compared with some Tibeto-Burman and Tai-Shan ethnic groups of Myanmar, Mon peoples were found to have a shorter cephalic length, wider cephalic width and greater cephalic index.

Results of this study will be useful in anthropological determination of physical traits of the ethnic groups of Myanmar and also in forensic medicine, reconstructive surgery, genetic studies and ergonomics of appliances.

P3-PA13

Severe lead contamination in children of samurai families in the Edo period Japan

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We analyzed lead concentrations in bones from both genders of the Japanese samurai class (Sohgenji site) of the Edo period (1603~1867) and compared them with those of the farmer (Kami-shozu site) and chonin (Kyo-machi site) classes to clarify gender and hierarchical or occupational differences in lead exposure during the Japanese feudal era. The chonin, or townsman, was a social class that emerged in Japan during the early years of the Tokugawa period. The majority of chonin were merchants, but some were craftsmen. These two classes of samurai and chonin lived in the castle town of Kokura, the present main town of Kitakyushu City which was ruled by the Ogasawara family (Daimyo) and their retainers from 1632 to 1866 . The chonin lived in the castle town in order to serve the samurai.

The bone lead concentration in the females of chonin (90.8 μg Pb/g, n=20) was significantly higher than that of males (39.9 μg Pb/g, n=31, $p<0.01$). The next most polluted population was the samurai class. The concentration in females (30.5 μg Pb/g, n=11) was higher than in males (15.6 μg Pb/g, n=11), but it was not significant. The least polluted class was the farmer (4.9 μg Pb/g one male, 10.4 μg Pb/g one female). The people of the farmer class lived on the outskirts of the castle town and were prohibited from using luxury goods by decree.

The samurai and chonin spent their life in the castle town Kokura. Their children might have been similarly polluted by lead. Samurai children had deadly levels of pollution (1241.0 μg Pb/g, n=21), and their value was forty fold that of their mothers (samurai females). Chonin children were commonly polluted (390.1 μg Pb/g, n=17), but their value was only four fold that of their mothers (chonin females).

P3-PA14

Effects of additional X and Y chromosome on maxillary permanent molar crown morphology in sex chromosome aneuploidies

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In this study we assessed the relationships between tooth crown size and crown morphological traits in males and females with additional X and Y chromosome, such as females with 45,X- and polysomy X karyotype, and males with 47,XXY- and 47,XYY karyotype.

Tooth crown diameters and classification of the traits in maxillary permanent molars were from the dental cast belonging to the KVANTTI Research Project headed by Prof. Alvesalo in Finland. The expression of molar crown traits, i.e. Carabelli's cusp and development (reduction) of the distolingual cusp, were divided into two grades with reference to Dahlberg's plaques (Dahlberg1951, 1956). The population controls were males and females from a rural community on the island of Hailuoto in Finland.

The tooth crown diameters increased in the order of 47,XYY karyotype, polysomy X, 47,XXY-, 46,XY-, 46,XX-, and finally 45,X karyotype. The frequency of positive expression of Carabelli's cusp was higher in polysomy X-, 47,XYY- and 47,XXY karyotypes than population controls and 45,X karyotype, although there were no significant differences between the groups. Absent of distolingual cusp in the maxillary first permanent molars was seldom found in polysomy X-, 47,XYY- and 47,XXY karyotype and population controls, whereas absent of the cusp in maxillary second permanent molars was higher in 47,XYY karyotype than other groups.

The increasing of Y chromosome have a strong influence on the overall crown sizes of the maxillary first and second permanent molars than those of X chromosome. Those karyotypes directly influence tooth germ development in an early stage of human odontogenesis. The later forming cusps, such as the distolingual cusp and Carabelli's cusp, may be affected by this developmental prerequisite.

P3-PA15

Anthropometric Comparison of Nasal Parameters Between Male and Female Students of Yoruba Tribe

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This study was carried out to provide nasal index baseline data among Students of Yoruba tribe for anthropometric and clinical applications. The study was carried out on students (male and female) aged between 18-24 years after necessary consent was obtained. The measurements (Nasal length and Nasal breadth) were taken with the aid of sliding caliper, while the nasal index (NI) was calculated as a ratio of the nasal length to nasal breadth. All data were statistically analysed.

Our results showed a mean NI± SD of 73.62± 14.61 in female which is slightly higher that of males who has NI ±SD of 72.77 ±12.25, these results are comparable with other studies. The nasal parameters didn't show sexual dimorphism.

In conclusion, based on the mean NI, the predominant nose type is Mesorrhine with 78.04% in both male and female students of Yoruba tribe. This data provides baseline data valuable in nasal anthropometry for clinical practice, in reconstructive surgery, rhinoplasty and in forensic science.

Key words: Nasal index, Nasal Anthropometry, Rhinoplasty, Mesorrhine.

P3-PA17

Correlation Between Finger Prints, Abo-Blood Groups And Haemoglobin Genotype Of Voluntary Blood Donors In Isth, Irrua Edo State, Nigeria

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Identities are a set of physical characteristics, functional or psychic, normal or pathological that defines an individual. Recently, there has been an increased interest in biometric technologies that is human identification based on one's individual features. The various identification data used are fingerprints, handwriting, bite marks, DNA fingerprinting etc. Fingerprints are constant and individualistic, hence form the most reliable criteria for identification.

This study aims to examine the relationship between Digito-palmer dermatoglyphic patterns in ABO blood groups and Haemoglobin Genotype among voluntary Blood Donors at Irrua Specialist Teaching Hospital, Irrua.

The subjects (42 males and 31 females) were selected via a random sampling technique and fingerprint determination was performed using the Indian ink method. Palm and fingerprints were observed for the angles connecting the triradii at the roots of the fingers taken as atd, tad and tda angles. Blood was collected and analysed for blood group and Genotype using electrophoresis. The data collected was statistically analyzed using the SPSS version 20, with the student t-test, chi square test and ANOVA used as statistical tools.

Blood group O was more likely to present with Ulnar Loop (UL) fingerprints while mean Right TDA (61.06±8.39o) and Right ATD (42.03±3.930) were higher in blood group A but triradius angle were not significantly different ($p>0.05$) across the blood groups. Also, RL and UL fingerprints were more likely to be common among AA than in AS while triradius angle were not significantly different between Hb-AA and Hb-AS.

Relationship does exist between dermatoglyphics, blood group and Hb genotype. Persons who present more with Radial Loop fingerprints are more likely to be of AA genotype than in AS while individuals who present with Loop (L) fingerprints are more likely to belong to blood group O. These parameters may help in early diagnosis.

P3-PA18

Discriminant function analysis as a proof for sexual dimorphism among the Yoruba ethnic group of Nigeria: A cephalometric study

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Forensic scientists study human skeleton in legal setting. Discriminant function analysis has become important in forensic anthropology. The aim of this study is to determine sex of adolescent Yoruba ethnic group of Nigeria using discriminant function analysis. Informed consent of the subjects were sought. One thousand subjects (500 males and 500 females) were used. Eight cephalometric parameters were measured, head length, head width, bizygomatic distance, skull height, upper facial height , lower facial height, total facial height and nose width. Discriminant function analysis was done. In the result, discriminant function score equation was determined for both direct and stepwise approach for the determination of sex of adolescent Yoruba population of Nigeria with between 89.70% (direct) and 91.10%(stepwise). The study concluded these cephalometric parameters are sexually dimorphic and therefore could be used in sex determination especially in crime scenes where the body is mutilated but the head is left intact.

P3-RA6

Innovative Technique to Utilize Donor Cadavers When Teaching and/or Maintaining Ultrasound Skillsets

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Acquiring ultrasound imaging and identifying subsequent anatomy is strongly sought after and time has been created in virtually all medical school curriculums. Most expose medical students during their clinical curriculum and some institutions are integrating ultrasound training during basic science curriculum. Universal problem is not enough ultrasonographers available to teach. Rarely is ultrasound taught simultaneously with anatomy lab because vessels are collapsed following the embalming technique. Surface and structural anatomical understanding of human body is paramount to acquire and interpret diagnostic quality ultrasound imaging. Simulation ultrasound can be helpful, but not comprehensive for a novice to transition to live subjects effectively. Objective of this study was to provide a perfusion technique to donor cadavers which would enable students/trainees to ultrasound cadavers with a full vascular system and appreciate orientation of surrounding structures. Novel safe contrast agent and perfusion technique was successfully administered to embalmed cadavers (6) resulting in contrast filling the arterial and venous systems. Ultrasound linear and phased array probes acquired imaging of limb, thoracic, and abdominal vessels. Interestingly, the contrast filled the bladder in some cadavers and allowed ultrasound of the pelvic region with a full bladder. All cadavers were CT scanned post perfusion. This study revealed a contrast agent can be perfused into a cadaver providing opportunities to learn surface anatomy for ultrasound probe placement while identifying structures prior to dissection. IRB approval granted for cadaver research.

P3-RA7

Normal renal dimensions of elderly healthy subjects at sonography according to the side of the kidney and gender

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Normal renal dimensions have been studied extensively by ultrasound examination, but it must be emphasized that in these works contradictory data are presented and quantitative parameters of normal renal sizes are not well documented. There are many reasons for this: in some works of this type are ignored the effect of gender and side of kidney , subjects being studied had diseases in which the kidney is involved (for example diabetes mellitus) and so on. The Aim of present research was to study normal renal dimensions of elderly healthy subjects at sonography according to the side of the kidney and gender. In Todua Research Institute of Clinical Medicine sonographic measurement of 49 kidneys (14 male and 35 female kidneys, 21 left and 28 right kidneys) of elderly healthy subjects 56 - 74 years of age were performed; ethical approval was obtained from the local ethical committee of this Institute. The length (pole to pole), width and thickness of the kidney, as well as the size of its parenchyma (in millimeters) were measured. Data was processed in the special statistical program IBM_SPSS_2015. The T-test comparison of the average was used. It was established that there were no statistically significant differences between right and left side not in women , nor in men in kidney length (women – 93.63±6.83 and 93.50±6.49, P=0.936 ; men – 93.44±2.99 and 94.60±1.74, P=0.305), in kidney width (women – 41.68±4.81 and 39.56±3.02, P=0.077 ; men – 44.89±5.34 and 43.60±4.59, P=0.497), in kidney thickness (women – 36.74±2.88 and 35.63±3.26, P=0.120 ; men – 35.56±3.34 and 35.00±4.69, P=0.514) and in size of its parenchyma (women – 15.63 ±1.98 and 15.00±1.97, P=0.193 ; men – 15.00±2.05 and 15.80±2.48 , P=0.303). By comparision of quantitative parameters of renal dimensions in men and women no statistically significant differences were detected.

P3-RA11

The radiologic anatomic relationship between human maxillary first molar and maxillary sinus

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The relationship between maxillary posterior teeth and maxillary sinus is of clinical significance. The aim of this study was to assess the radiologic relationship between the maxillary sinus and the root apices of the maxillary first molar using CBCT. 325 CBCT scans of patients aged 20-70 years old were analyzed. Patients were divided into 3 age groups: young group (20-44 years); middle age group (45-59 years) and elderly group (60-70). The anatomic relationship between the maxillary sinus and maxillary first molar was recorded according to Kwak's Classification as following: Type I: The inferior wall of the MS floor is located above the root apex of the buccal and palatal roots, Type II: The inferior wall of the MS is located below the level connecting the buccal and palatal root apices without an apical protrusion over the MS, Type III: An apical protrusion of the buccal root apex is observed over the inferior wall of the MS, Type IV: An apical protrusion of the palatal root apex is observed over the inferior wall of the MS, Type V: Apical protrusions of the buccal and palatal root apices are observed over the inferior wall of the MS. Type I was observed in 20.9%, 23.2% and 35.5% in young, middle and elderly group, respectively. While type II was most common in 58.6%, 71.2% and 64.5% in young, middle and elderly group, respectively. Type V was higher in young group in 6%. The root apices of maxillary first molar touch the maxillary sinus floor in most cases. This anatomical relationship should be taken into consideration during surgical or endodontic treatment.
The ethical approval: the study was performed by analyzing the CBCT scans of human subjects attending the radiologic diagnostic center for three dimensional radiological scanning, after taking their written consent to analyze their scans.

P3-RA13

The branching angle in bifurcated spinous processes in cervical spine

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Bifid spinous processes are characteristic for typical cervical vertebra. There are no detailed and objective data on the differences in the degree of bifurcation of spinous processes in scientific literature.
We retrospectively analyzed CT examinations of the cervical spine performed in 200 adult human. To determine the exact dimensions of the spinous process and to characterize morphology of bifurcation the following parameters were used: length of the spinous process base, length of the spinous process branch and branching angle. The protocol of the study was accepted by the the Local Bioethical Commission of Medical University of Lodz.
There were no significant differences between sexes in any of the analyzed parameters. The spinous process base was significantly longer in CII and CVII than in other vertebrae ($p<0.0001$). The spinous process branches were significantly longer in CVI and CVII than in the other vertebrae ($p<0.0001$). The branching angle differed significantly between the body sides. On the right side it was significantly more obtuse than on the left side ($p=0.0002$). The branching angle analyzed separately for each bifurcated spinous process was significantly sharper in CII and CVII than in CIII-CVI vertebra on the right side and CIII-CV on the left side ($p<0.0001$).

The branching angle in all bifurcated spinous processes was significantly sharper in CII and CVII. We introduced new, objectified parameters of morphological variability of the cervical spine spinous processes.

P3-RA14

Phase-contrast Synchrotron Radiation micro-CT Shows Defective Internal Elastic Lamina of Atherosclerotic Human Cerebral Arteries

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Reliable, noninvasive imaging modalities to characterize plaque components are clinically desirable for detecting atherosclerotic plaques, which cause ischemic stroke. Although clinical developments in CT and MRI have enabled the visualization of calcified plaques in arteries, the identification of non-calcified plaque components remains difficult. The purpose of this study was to image atherosclerotic lesions by using phase-contrast synchrotron radiation (SR) micro-CT, and to investigate whether this method could identify differences in plaque components. Ex vivo SR micro-CT of human arteries was performed at the 6C beamline of Pohang Accelerator Laboratory (PAL), Korea. Arterial samples were collected postmortem from individuals who donated their bodies with informed consent for teaching and research purposes to CUD, Korea. The atherosclerotic middle cerebral arteries and basilar arteries were exposed to synchrotron radiation and 1000 projection images were obtained by rotating the vessel through 180o. An X-ray shadow of a vessel was converted into a visual image by the scintillator. After micro-tomographic reconstruction, the three-dimensionally reconstructed images were further segmented into the plaque components, internal elastic lamina and arterial wall. Samples were also histologically analyzed. Phase contrast SR micro-CT revealed atherosclerotic plaque components, wall structures, and defects in internal elastic lamina (IEL) easily. The specific mass densities of these plaque components were quantitatively estimated. Moreover, the defect in IEL with intimal thickening was observed in all atherosclerotic cerebral arteries. The defects in the continuity of the IEL would allow smooth muscle cells to proliferate into the intima and the invasion of the plaques into the tunica media. In conclusion, the defects in the IEL may play a role in the pathogenesis of intimal thickening and atherosclerosis in the human cerebral arteries. Phase contrast SR micro-CT provides a useful tool for the investigation of plaque components and wall structure of atherosclerotic arteries.

P3-RA15

Micro CT visualization of metaphyseal growth plate as a tool to evaluate the mode of growth in Iguanid lizards

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Growth plate cartilage (GPC) is responsible for the growth of long bones due to endochondral ossification, which is the main mechanism of longitudinal skeletal growth in tetrapods. Degradation of GPC is a sign of determinate growth as it arrests the growth irreversibly. By contrast, indeterminate growth requires the persistence of GPC throughout the entire life.

The goals of our study were (1) to verify that µCT has sufficient resolution and contrast for unambiguous detection of the presence/absence of growth plates in long bones, and (2) to

reinvestigate mode of growth in lizards, which is usually considered as indeterminate.

To visualize GPC on the proximal part of the femur, we employed micro-radiography and micro-computed tomography. Micro-radiography was used for the initial visualization. In smaller samples and/or in bones with the progress of growth plate degradation, we employed µCT with high magnification and spatial resolution capability suitable for the following 3D image analyses. The imaging systems were equipped with semiconductor hybrid pixel detectors based on the Timepix technology. The high-resolution set-up features a micro-focus X-ray tube and a large field of view. Thanks to the cone-beam imaging geometry, it is suitable for imaging with high magnification factors and spatial resolution better than 5 µm.

We analyzed 95 long bones of iguanid lizards and found that the employment of micro-radiography and µCT enables detailed visualization of GPC. The universality of indeterminate growth of squamate reptiles has been challenged again. We suggest that the dual type of growth represents an extreme case of heterochrony.

P3-RA16

A Novel Approach to the Earliest Virtual Dissection of the Ventral Amygdalofugal Pathway In-Vivo

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The ventral amygdalofugal pathway is a short neural tract that serves as a key output of the amygdala. It divides into five main branches terminating at the hypothalamus, dorsomedial nucleus of the thalamus, septal region of the cerebrum, nucleus accumbens and brainstem. This tract and its branches have hitherto been visually unattainable with standard neuroimaging, but using advanced diffusion-weighted magnetic resonance (MR) technologies and virtual reality (VR) we present for the first time a virtual in-vivo dissection of this tract.

90 healthy subjects were scanned using High Angular Resolution Diffusion Imaging (HARDI) and high-resolution T1 (1mm isotropic) MR imaging at Trinity College Dublin (Phillips, Intega 3T). 3D amygdalar and nucleus accumbens volumes were generated using automated cortical segmentation with FreeSurfer 6.0. These digital analogues were used to extract the ventral amygdalofugal pathway and its branches through a neuroanatomically derived boolean logic protocol of the diffusion data. Post-generation tract analogues were converted in 3DS Max and visualised in a Unity3D/Oculus Rift VR environment allowing for intracerebral virtual manipulation and individual isolation of generated elements. Ethics approval was granted by St. James/Tallaght joint REC.

Using our protocol, we were able to reliably visualise, quantify and manipulate the ventral amygdalofugal pathway in-vivo. High inter-rater reliability was confirmed via interclass correlations. This is the first time that this tract has ever been radiologically isolated and demonstrates how both new neuroimaging and VR techniques can synergise to inform neuroanatomy. Macroscopic and microscopic data can be calculated from these virtual tracts to potentially investigate various neuropsychiatric conditions. In particular, this tract may show differences in illnesses which involve amygdalar, neuroendocrine and autonomic pathology such as depression, anxiety, PTSD and schizophrenia.

In summary, this is the first time the ventral amygdalofugal pathway and all of its major branches were virtually dissected and visualised using VR.

P3-RA17

Age and Sexual dimorphism of paranasal air sinuses: A radio-morphometric and volumetric

evaluation using multi-detector computed tomography

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Identification of an individual after mass calamities such as tsunami, explosions, aircraft crashes etc. pose challenges to the experts when bones are fragmented. Dense bones like maxilla surpass this challenge, remain intact with sinuses even after incineration thereby making the dimensions of the sinuses an ideal and reliable tool in forensic science. Noninvasive imaging techniques like Computed Tomography (CT) can be used to evaluate such cases and help detect fractures and further locate foreign bodies.

Keeping in mind the diverse importance of air sinus morphometry, this study was aimed to measure the dimension and volume of frontal, maxillary and sphenoidal air sinuses on CT scans and to note age and gender dependent changes in these sinuses.

CT images of 158 patients without any pathology of paranasal sinuses, age ranging from 19 to 73 years were obtained. Written consent was taken from patients prior to the study. Approval from the institutional ethical committee was obtained. Statistical analysis for all the parameters was done using SPSS 19.0 and significance was set at $p<0.05$.

Bilateral anteroposterior length and height of the frontal sinus in males was significantly more compared to females ($p<0.05$). In case of maxillary and sphenoidal sinuses overall dimensions was significantly higher in males than the female patients ($p<0.05$). Likewise, overall volumes of frontal, maxillary and sphenoidal sinus, was also significantly greater in males compared to females ($p<0.05$).

There was no age-related significant correlation seen in the dimensions and volumes of all the sinuses.

The results obtained from this study show that imaging can be used as a reliable tool for personal identification in forensic anthropology and criminal investigations. In addition, countries where autopsies are declined, due to ethnic or religious purpose, can implement this method to document possible injuries and clarify the mode and cause of death of an individual.

P3-RA18

Morphology-morphometry analysis of upper incisors and the anatomical relationship with the floor of the nasal cavity in humans by cone-beam computed tomography (CBCT)

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There are reports of an increase in the rate of surgical interventions in the anterior maxillary area. Potential risks and the importance of anatomical study have been highlighted. We aimed to evaluate the morphology-morphometry of upper incisors and the anatomical relationship between the root apex and the floor of the nasal cavity, through a novel measurement proposal. Fifty digitalised cone-beam computed tomography (CBCT) scans of upper incisors region from patients aged 18 to 55 years were obtained. The analysed outcome measurements were I) distance from the root apex to the floor of the nasal cavity, II) floor thickness of the nasal cavity, III) root length, IV) coronal length, V) presence of apical constriction, and VI) apical morphology. The statistical analysis was performed using JMP version 14 software. The outcome measurements were compared using an analysis of variance and t-student test for independent samples. Differences with a value of $p<0.05$ were considered statistically significant. Of the total images evaluated, 15 corresponded to women and 35 to men, the mean age was 26.62 ± 9.754 years. The radicular and coronal length were

significantly higher in men than in women, however there was no statistically significant relationship of the sex and age variables with the distance from the root apex to the floor of the nasal cavity, floor thickness of the nasal cavity, presence of apical constriction or apical morphology. The results of this study and the proposed measurement scheme could be helpful in the dental specialties that cover this anatomical area.This is especially relevant in the maxillary anterior region due to the limited availability of alveolar bone and the proximity to the nasal cavity.

Ethical approval status: This study was initiated after obtaining institutional ethics approval.

P3-RA19

Calcium density of the coronary artery: multi-image analysis using human cadaver

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Spotty calcification (< 3-mm in size) of the coronary artery detected by clinical computed tomography (CT) is regarded as one of the features of vulnerable plaque. However, the morphological differences between spotty calcification and large calcification are not yet well understood. The purpose of this study was to compare spotty calcification with large calcification by using clinical CT, experimental micro-CT and histopathological images. This study was approved by the institutional review board. The study comprised 20 coronary arteries harvested from 10 human cadaver hearts. These coronary arteries were examined by using a clinical CT. The CT value of calcification (spotty & large) was measured and statistically compared between large calcification and spotty calcification. Also, experimental micro-CT and histopathological images in the portion of calcification were generated and visually compared between spotty calcification and large calcification. A paired t-test was used for statistical analysis. A value of $p < 0.05$ was considered statistically significant. Continuous Data was expressed as mean ± standard deviation. Clinical CT detected 11 spotty calcifications and 16 large calcifications. The CT value of spotty calcification was significantly lower than that of the large calcification (372 ± 168 Hounsfield units (HU) vs 891 ± 193 HU; $p < 0.05$). The micro-CT and histopathologic findings revealed spotty calcification had numerous microcalcifications compared with large calcification. Spotty calcification contains the aggregate of multiple microcalcifications, while large calcification is the mass or fragments of calcification. This is why the CT value of spotty calcification is lower than that of large calcification.

P3-RA20

Anatomical study of the meniscofemoral and transverse ligaments, and their importance in magnetic resonance imaging

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Of the ligamentary group of the knee, closely related to the meniscus, we highlight the presence of the transverse and meniscofemoral ligaments. Variability in their presence and characteristics has been reported.

Additionally, in magnetic resonance imaging (MRI), transverse ligament often mimics an

anterior horn meniscal tear; and meniscofemorals mimic posterior horn tears of the lateral meniscus.
The objective was to study the frequency and morphological characteristics of these ligaments in human corpses and MRI.
16 adult cadaveric knees, fixed in formaldehyde solution, were dissected. Lenght and thickness (proximal, middle, distal) of the ligaments were measured. MRIs of knees of adult patients, acquired since January 2019 in Hospital de Clínicas of Montevideo, were reviewed. Exclusion criteria: pathology of the posterior cruciate ligament.
The preliminary results of the dissections showed the presence of: the transverse ligament in 13 cases (81.25%), anterior meniscofemoral ligament in 7 cases (43.75%), and posterior meniscofemoral ligament in 6 cases (37.5%). The average length and thickness for them were: 31.3 mm and 3.1 mm, 24.5 mm and 5.98 mm, 24.5 mm and 6.41 mm, respectively.
38 MRI studies were reviewed, 1 with exclusion criteria. The absolute frequency of the ligaments was: transverse: 18 cases (48.6%); anterior meniscofemoral: 34 cases (91.9%); posterior meniscofemoral: 33 cases (89.2%).
Regarding the absolute frequencies, there are significant differences between dissections and imaging findings. No significant differences between dissections and findings reported in the literature were found.
Biases are recognized.
It's essential to know the presence of this ligaments, as they mimic meniscal tears in MRI.
The corpses on which dissections were performed were obtained from voluntary donors who expressed their consent in life in our medicine University. Personal data is not disclosed in MRI, perfomed at Hospital de Clínicas, Universidad de la República, Montevideo, Uruguay.
The authors have no ethical conflicts to disclose.

P3-RA21

Artificial Intelligence as an effective assistant for a chest X-Ray interpretation

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Chest X-rays are the most common type of radiology examinations in the world and a particularly challenging example of multi-label classification in medical diagnostics.Medical diagnostics have increasingly become a more interesting and viable endpoint for machine learning. Our AI solution for chest X-Ray interpretation has been built as convolutional neural network on a base of top-rated architectures such as InveptionV3, ResNet, DenseNet.The network carries out a primary analysis and issues a report, which allows a radiologist to detect X-Ray findings faster, interpret them correctly, and spend seconds revising images without pathology. As a result, it spares an observer's time to focus on more complicated cases.Our network precisely detects an occurrence or absence of lung pathology. And the efficacy rate surpasses the one of human observation. General lack of publicly available medical data inhibits AI rapid development. However, we have arranged to train the network on about 200000 depersonalized images obtained as from our clinical partners as from open access datasets. Training is a pivotal point at neural network development. So, our IT team has built easy operating Label software. We accumulate all nameless images there, which then training officer distributes independently to three remote radiologists listed as possible options for the task and linked to appropriate training algorithm. Each radiologist has its own account secured by login and password with list of images pending for labeling. Labeled and uploaded images convey to the network for training. Regularly we test our net and, therefore, monitor its efficacy using well-known metrics. Accuracy of lung pathology interpretation fluctuates between 80 and 98%. It depends on the kind of the organ impairment, and, at the same time, is associated with the size of training dataset.

P3-RA22

Anatomy and Variations of the Vertebrobasilar System Examined

with Digital Subtraction Angiography

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The posterior circulation of the brain constitutes the vertebrobasilar system and its branches, which are responsible for about 30% of the brain blood supply. The aim of this study was to examine the anatomy and variations of vertebrobasilar system with DS angiography.
We examined radiographs of 55 patients who had DS angiography undertaken for a variety of clinical reasons, performed as a part of their medical treatment at the University Clinic for Radiology in Skopje. This study was approved of the Macedonian Ethical Committee. The study population included 27 male and 28 females, age range from 18-79, mean age 51.09 years.
The left VA originated from the subclavian artery in 96.36% and in 3.63% had variable origin from the aortic arch. The right VA without exception had origin from the subclavian artery in 100%. Most of the SCA arise from the basilar artery as a single vessel (92.7% on right and 94.5% on left). The most common variations of the SCA were duplication (frequency 3.63% on right and 1.81% on left) and origin from PCA (frequency 3.63% bilateral). Adult configuration of PCA was present in 74.54%; fetal configuration was present in 20% and transitional configuration was present in 5.45% of the patients on the left side. On the right side adult configuration was present in 83.63%; fetal configuration was present in 14.54% and transitional configuration was present in 1.81% of the patients.
Through knowledge of the anatomy and variations of the vertebrobasilar system is important to clinicians on daily basis for save performance of diagnostic and interventional procedures in radiology and for surgeons during planning and accomplishing surgical interventions. For the anatomists, the results obtained from this study present valuable teaching material for students and postgraduates.

P3-RA23

Clinical imaging study of the sciatic nerve in the paediatric knee: implications for popliteal approach of sciatic nerve blockade in children

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In paediatric patients, regional anaesthetic blockade of the sciatic nerve is useful for postoperative pain relief after surgical procedures of the lower limb. The success of the nerve blockade is significantly determined by the accurate and reliable identification of the sciatic nerve and its branches relative to the surrounding anatomical structures around the knee. However, current literature has demonstrated complications arising from the inconsistent and incomplete understanding of the anatomy of the structures in the knee region especially in children. There is a strong paucity of information regarding the location of the nerves relative to the surrounding structures in the knee, particularly throughout the paediatric development. This clinical imaging study therefore aimed to document and analyse the relative morphometric relationship of the nerves in the knee region, throughout the different stages of paediatric development. The locations of the sciatic, tibial and common fibular nerves were measured in relation to relevant anatomical structures in 142 paediatric Magnetic Resonance Imaging and Computed Tomography, which were obtained from the Sydney Children's Hospital following ethical approval (LNR/16/SCHN/387). A strong correlation was found between age and the distance from the common fibular nerve to the semitendinosus muscle, and thus can be used

to predict stature. Significant differences were found between males and females, specifically after puberty, suggesting that sexual dimorphism emerges more distinctively at puberty. In order to predict the location of the nerves at the popliteal fossa, a regression formula using the patient's age and bicondylar width was created. These finding may have significant implications for popliteal approach of the sciatic nerve blockade in paediatric patients of all age groups.

Workshops

Introduction to Wikipedia for anatomists

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Wikipedia is the largest online encyclopaedia whose content is created by collaboration of over seven-million volunteers. Since its creation in 2001, its popularity has been growing, and is read by 1.4 billion of people every month. In the medical community, it was revealed that Wikipedia is used by 90% of medical students and is also ranked number one by 56% of medical students for their most preferred online anatomy resource. Also, Wikipedia is often the initial source of information for students and health professionals searching for quick information about anatomical structures. Over the years, Wikipedia has received justifiable criticisms regarding the quality of its entries. There have been studies evaluating the accuracy and quality of Wikipedia articles across disciplines. Most of them found out that Wikipedia articles are generally accurate, albeit with some errors of omission. To improve the content of Wikipedia entries, there are several ways in which academics can contribute to the Wikipedia ecosystem. The Education Program is a platform that allows educators and students to contribute to Wikipedia in an academic setting. WikiJournal of Medicine was introduced as a bridge between the Wikipedia community and the academia. Content published in this journal are integrated into Wikipedia, and at the same time authors are rewarded with citable publications. As part of the workshop, the quality of Wikipedia articles across subjects in medicine especially in anatomy was explored. The audience was demonstrated how Wikipedia works, where it sits in modern education, and how we as anatomists can be part of it.

International Anatomy Workshop: Connecting Anatomists and Global Health

Anette Wu[1], Geoffroy Noel[2], Chung-Liang Chien[3], Daniella Curcio, Michael Hortsch[4], Mamata Chimmalgi[5], Richard Wingate[1]

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Chaired by Anette Wu and Geoffroy Noel, this workshop consisted of three parts:

1) Spectrum of international work: Panelists shared examples of the scope of international initiatives. Talks included "Multidirectional Near Peer Training Program between Haiti, Rwanda, and Canada: Values at home and abroad" (Noel); "How to leverage resources and secure funding for international partnerships" (Chien); "Building Bridges: Medical Education and the Anatomical Sciences - Brazil and the US" (Curcio); "Internationalization of medical education and the anatomy course – an international 12 school partnership" (Wu); "The role of modern technology in changing anatomical education around the world - utilizing the Virtual Microscopy Database (VMD)" (Hortsch); "Classroom without boundaries" (Chimmalgi); and "International outreach with school children: Bringing school children from India and the UK together through imagined anatomies" (Wingate).

2) Skills to create and grow international programs: Panelists addressed the skills and processes involved in building networks (using a defined set of criteria for identifying partners, leveraging professional societies and organizational networks, connecting with other disciplines and school officials); involving university networks for funding; the role of technology; involvement of students; how to avoid pitfalls and learn from mistakes (such as prior need assessment, discussion of end-points, involvement of student chaperons, ethics, cultural and historical backgrounds); and how to use the "4Es" (Edit - Expand - Evolve - Empower) to maintain and grow an international program.

   A Q&A session on how to find partners ensued.
3) Networking to foster new partnerships: Participants formed small interest groups focusing on global health (i.e., medical education - including Anatomy and beyond, basic sciences research, clinical projects and research, Public Health research, technology), to discuss ideas, exchange contact information, and start collaborations in global health.

   3 and 6-month follow-ups are scheduled by the workshop chairpersons as a support resource to help participants achieve the goals that were set in the workshop's networking activity.

IFAA President's Emergent Anatomists Programme (PEAP) Inaugural Workshop

Prof Beverley Kramer[1], Prof Nalini Pather[2], Dr Carol Hartmann[1], Dr Erin Hutchinson[1], Ms Francesca du Toit[3], Prof Lynne A. Opperman[4], Prof Akira Shinaoka[5], Prof Darrell JR Evans[6], Prof Laura Borgno[7], Dr Segun Oyedele[8], Prof Diogo Pais[9], Prof Guido Macchiarelli[10]

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An oocyte does not survive on its own. As it grows and matures a variety of surrounding cells sustain it. This metaphor, presented by Professor Macchiarelli in the closing remarks of the inaugural workshop of the IFAA PEAP, which focused on mentoring and its role in the development of an anatomist, captures the key message of the programme.

In the keynote address, Professor Opperman highlighted passion for her work and the valuable role of mentors and collaborators throughout her journey of becoming a respected, successful anatomist. Encouraging workshop participants to celebrate the small achievements, she urged them to take full advantage of new opportunities to learn and grow, even in areas not originally envisioned. These ideas were echoed by the international panel of established anatomists as they shared their journeys and advice. Themes emerged of celebrating achievements, viewing challenging situations as opportunities for learning and growth, prioritising what is important for you, finding ways to contribute to the development of others and the need to surround oneself with colleagues, peers and mentors who will listen, challenge and encourage.

Following the panel discussion, participants discussed the challenges they face and initiatives they would find helpful. Similar to the results of a global survey of emergent anatomists which were presented in the workshop, participants highlighted the need for resources and initiatives that facilitate the development of emergent anatomists as teachers and researchers. A strong theme emerging from the 63 participants was the need for emergent anatomists to connect, collaborate and communicate with peers and senior anatomists, locally and internationally. The IFAA PEAP aims to facilitate this through a mentorship programme, workshops at future congresses and communication initiatives which will be launched in the months following the workshop.

21st Century Anatomists: Social Media Use in Anatomy Education and Research

Catherine Hennessy[1], Kirsten Brown[2], Mike Pascoe[3], Iain Keenan[4], Jane Holland[5], Amanda Meyer[6] and Danielle Royer[7]

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Roughly 50 delegates attended this two-hour workshop, which involved speakers sharing their research and experience on how to best use social media for both professional networking purposes and as educational tools. The platforms covered included Instagram, Snapchat, Twitter and Facebook. Delegates were given tasks to complete on Twitter throughout the workshop. The challenges of using social media within the field of anatomy, including the increasing number of posts containing cadaveric material being shared publicly were discussed. Attendees also reflected on their online presence and how to optimize their online identity.

A post workshop evaluation form was circulated and 22 completed forms were returned. Ninety-five percent of respondents reported that they had learned something new about how to use social media as a result of the workshop, with 73% of respondents intending to use social media more for teaching and 82% intending to use social media (namely Twitter) more for professional networking. Twitter and Instagram were the two most popular platforms attendees intended to use as teaching adjuncts, however two attendees intended to use Snapchat. A relatively low proportion of attendees (27%) opened or intended to open a social media account as a result of the workshop suggesting that attendees already had social media accounts and attended the workshop for further advice on how to use the platforms. Fifty-five percent of respondents intended to make changes to their online presence after the workshop. Attendees were asked what other actions they intended to take and open-ended responses revealed: using social media more for public engagement, giving more consideration to their online audience, joining the social media community of anatomy associations and applying more structure to their social media use. Attendees commented on the usefulness of hearing the practicalities of using different social media from a wide variety of experienced perspectives. Verbal and written feedback from attendees revealed a growing concern for the ethical and professional challenges of using social media in anatomy, including sharing cadaveric images on social media, which attendees feel needs more emphasis in the anatomy community.

#mylifeinanatomy

Claire Smith[1], Darrell Evans[2], Cecilia Brassett[3], Siobhan Connolly[4], Gabrielle Finn[5]

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My life in anatomy aimed to provide a candid discussion to celebrate and critique the opportunities and barriers facing career anatomists today. Attention has been paid to academics experiences through initiatives like Athena Swan at an individual institutional level. However, anatomists are often only one or two per institution and reply heavily on a national and international network for their own career development, support and mentorship. No research to date has explored anatomists perceptions of their working environment and wellbeing. The workshop talks explained personal journeys and demonstrated unique routes individuals had taken into their anatomy roles. The talks demonstrated the positive effect of supportive mentors and inspirational role models and the importance of collegial interactions, but also highlighted that some had experienced adversity in their personal and professional lives which had affected their journeys. The talks and subsequent discussions highlighted a variety of

issues covering both positive and negative within career transition, professional development, health and wellbeing, bullying and harassment. Discussion revealed that a number of anatomists had experienced some form of discrimination based on protected characteristics with gender and age being the most common. At the same time anatomists had found the national and international communities to be a largely supportive and welcoming environment, but not always free from the issues above. Discussion explained that social media over the past five years in particular, had helped connect anatomists around the globe, creating a virtual support and developmental network. The workshop highlights a need for national and international societies to further understand the issues raised, and to develop strategies to help promote a positive and life-rewarding experience for all current and future anatomists.

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