

VIRTUAL REALITY (VR) IN ANATOMY EDUCATION: ADVANTAGES AND CHALLENGES

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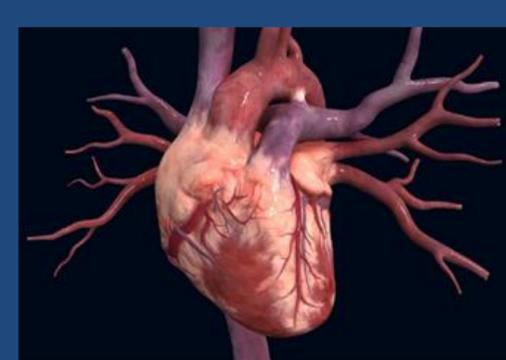


Figure 2: Heart as seen in VR (taken from Maresky et al., 2019).

INTRODUCTION/OBJECTIVE

Anatomy education has evolved throughout centuries, as early as 1600BC until the 21st century. In the latest decade, anatomy educators encountered different challenges ranging from limited number of cadavers, high-priced anatomical plastination and model. Recent COVID-19 pandemic has inevitably mold future anatomy pedagogy to better-adapt with the current digital-savvy generation. Among the technology advancement are flipped-classroom approach, 3D anatomical animation, mobile anatomy app system, and virtual reality (VR) anatomical organ. Despite the recent emergence of VR in anatomy, there are limited comparative analysis of the benefits and disadvantages of using VR platform in anatomy teaching & learning (T&L). Hence, this study aims to elucidate the advantages and challenges using VR as one of the teaching approaches in anatomy.

METHODOLOGY

A narrative review approach was conducted for this study. The research question was formulated based on PICO strategy. Subsequently, the authors have formulated the research question – What are the advantages and challenges in using VR in Anatomy education? Keyword identification and bibliographical search was performed using Scopus and Science Direct databases. Experimental studies published between 2010-2022, in English language and discussing on the application, advantages or disadvantages of VR in anatomy and medical T&L were selected and analysed.

RESULT

Authors	Year	Journal title	Materials / Method	Advantages	Disadvantages / Challenges
Falah, J. et al.	2014	Virtual Reality Medical Training System for Anatomy Education.	System/Region: Heart. Development of real-time 3D heart in an interactive VR environment. Users can interact by enlarging, minimising, rotating etc.	<ul style="list-style-type: none"> i. 3D VR of heart offers more realistic & hands-on. ii. Enhance visualisation (dissecting into layers & planes). iii. Develop skills for students (manoeuvring organ without involving patient). iv. Deeper understanding of complex heart structure and its relation to surroundings. 	<ul style="list-style-type: none"> i. Labelling. ii. Suggestion to add more detail anatomical information in the list of structures in the heart. iii. Navigating and manipulating with the system.
Maresky et al.	2019	Virtual Reality and Cardiac Anatomy: Exploring Immersive Three-Dimensional Cardiac Imaging, A pilot study in undergraduate medical anatomy education.	System/Region: Cardiovascular (Heart). 42 medical students divided into control (n=14) and variable (n=28) groups. Control group = independent study, Variable group (Cardiac VR). Pre- and post-intervention quiz done.	<ul style="list-style-type: none"> i. VR offers learner to interact 3D with heart anatomy (VR group scored higher than control group). ii. User enjoyment: VR is fun & effective tool for teaching cardiac anatomy, performance increase of 24.6% (P < 0.0001) in VR group. VR offers immersive experience to appreciate the size difference & to contextualize the relationships between different structures of heart. iii. VR group demonstrated significant improvement in their understanding of cardiac anatomy (28%, P < 0.001). iv. Although high-cost, the cost-benefit ratio sway in VR favour. Potential to expand to pathological condition. 	<ul style="list-style-type: none"> i. High cost. ii. Have a strong dislike to technology & suffer from vertigo. iii. Further research needed to determine the most effective ways to deliver this immersive content to learners – ultimately help to better understand how undergraduate anatomy education most benefited by VR in the future.
De Faria et al.	2016	Virtual and Stereoscopic Anatomy: When Virtual Reality Meets Medical Education.	System/Region: Neuroanatomy (Limbic). 84 students divided into 3 groups (n=28 each). 2D images vs interactive non-stereoscopic, vs interactive stereoscopic.	<ul style="list-style-type: none"> i. Pedagogical evaluation done after each method by asking the students to list the structures of the limbic system. Results show that stereoscopic method is an important resource to better understand anatomical relationships. ii. Capability to virtually “manipulate” the brain, examining with continuity of its multiple perspectives and structural relationship are important from pedagogical aspect. 	<ul style="list-style-type: none"> i. Eyestrain. ii. Impossibility of physical contact. iii. Authors suggest to combine immersivity, interactivity, stereoscopy, and easy application at affordable costs.
Moro et al	2017	The Effectiveness of Virtual and Augmented Reality in Health Sciences and Medical Anatomy.	System/Region: Skull. 59 participants randomized into 3 groups: Virtual reality (VR) group, Augmented reality (AR) group and Tablet-based (TB) application. All groups received an identical lesson presented in either VR (n=20), AR (n=17), or TB (n=22).	<ul style="list-style-type: none"> i. VR and AR promote intrinsic benefits such as increased learner immersion and engagement. ii. VR and AR could be an effective teaching tool. iii. VR and AR provide additional intrinsic benefits, such as increased student interactivity and enjoyment. iv. VR and AR are expected to become unique and powerful learning tools within health sciences and medical curricula. 	<ul style="list-style-type: none"> i. Participants reported headache, dizziness, and blurred vision. ii. No significant differences were found between mean assessment scores in anatomy question in VR, AR, or TB. <p>Limitation: Sample demographics - participants had taken anatomy course received higher scores. Authors suggest further study investigating the influence of these teaching tools for educating medical graduates and postgraduates.</p>

RESULT

Authors	Year	Journal title	Materials / Method	Advantages	Disadvantages / Challenges
Jang et al.	2017	Direct Manipulation is Better than Passive Viewing for Learning Anatomy in a Three-Dimensional Virtual Reality Environment.	System/Region: Inner ear. 76 medical students assigned to 2 groups: Manipulation VR group vs Viewing VR group in a yoked-pair design.	<ul style="list-style-type: none"> i. Manipulation group scored significantly higher in post-test. ii. Added value for directly manipulating virtual 3D structures. iii. Benefitted students with low spatial ability by directly manipulated VR anatomical structure. iv. A clear frame of reference while interacting. v. Enabled students to tailor their experience to their individual cognitive needs and interests. vi. Hand-held VR controller – designed to be highly intuitive & enable movement that were spatially congruent with the actions taken in physical model. 	<ul style="list-style-type: none"> i. Viewing group may simply not had enough time to generate effective viewing strategies.
Alfalalah et al.	2019	A Comparative Study between a VR Heart Anatomy system and traditional medical teaching modalities	System/Region: Heart. 60 medical students divided into VR group vs physical model group. The study was based on the student’s satisfaction, behaviours.	<ul style="list-style-type: none"> i. (VR) as a medical training tool to offer additional quality means to teach students. ii. VR heart enhanced students experience in anatomy learning and the provided tools improved their understanding of heart anatomy with higher satisfaction rate regarding structure and visualisation. 	
Reymus et al.	2020	VR: An Effective Tool for Teaching Root Canal Anatomy to Undergraduate Dental Students – A Preliminary Study	System/Region: Root canal (tooth). Dental undergraduates (n = 42) exposed to radiograph, CBCT scan videos, and finally VR tooth. Questionnaire - most helpful in understanding root canal anatomy, method with better didactic tool.	<ul style="list-style-type: none"> i. Students reported that CBCT and VR allowed them to detect all anatomic features more than radiography (P < 0.001 – P = 0.049). It improved comprehension of root canal anatomy. ii. Most of the students adapted well to the VR simulation. iii. Positive attitude of dental students towards teaching dental anatomy using virtual reality. 	<ul style="list-style-type: none"> i. CBCT & VR had comparable results in terms of ability to detect all anatomic features. ii. Some reported sickness, diplopic image and disorientation while using VR root canal anatomy.
Nakai et al.	2022	Anatomy Education for Medical Students in a VR Workspace: A Pilot Study.	System/Region: CVS, MSK and Nervous system. 30 medical students (Japan).	<ul style="list-style-type: none"> i. Able to magnify heart structure & muscle insertion. ii. Able to manipulate anatomical structures by moving and modifying them, which provided a strong advantage. iii. Have access to their course material from anywhere and anytime via a virtual space. 	<ul style="list-style-type: none"> i. Headset are needed. ii. Need more time to learn to navigate. iii. Motion sickness.

DISCUSSION AND CONCLUSION

A total of twenty-four research articles were retrieved. The studies suggest VR in anatomy education is beneficial as it is more realistic, hands-on, enhances visualization and enjoyable self-learning tool that increases learners’ engagement. This is especially in low-spatial ability learners that has difficulty to visualize the location and dimension of anatomical structures. VR may improve teaching effectiveness and level of anatomy knowledge. However, the disadvantages are high-cost equipment and risk of tools malfunction. Some experiencing extraneous cognitive load in learning new modalities, motion-sickness, and headache after using VR headgear. The results exhibit that the advantages of using VR in Anatomy education are extensive and outweigh the challenges. As VR device are more affordable, the current challenge has moved to exploring ways to utilize this advancement in anatomy T&L effectively. The authors concluded that there are many potential research areas such as maturing VR technology, establishing technological standard with high data quality, larger studies to determine VR role in anatomy learning, and training VR-related technicians in medical field, all of which can further be explored especially in Malaysia to enhance anatomy teaching and learning for the current and future generation.

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CERTIFICATE OF PARTICIPATION

This is to certify that

Dr. Nurul Asyiqin Yusof

has participated in

***2nd Malaysian Anatomical Association Conference
(MAAC)***

as

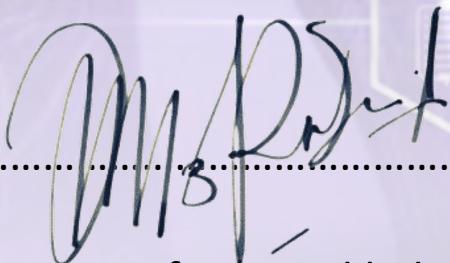
Poster Presenter

held on

2nd to 3rd November 2022

at

***Jen Johor Puteri Harbour by Shangri-La,
Iskandar Puteri, Johor, Malaysia***



Assoc. Prof. Dr. Madihah Rushaidi
Chairperson of MAAC 2022



Assoc. Prof. Dr. Siti Nurma Hanim Hadie
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2nd MALAYSIAN ANATOMICAL ASSOCIATION CONFERENCE

ANATOMY IN THE NEW NORMS

*Tracing New Trajectory in
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Welcome Message

Associate Professor Dr. Madihah Rushaidhi

Chairperson, Malaysian Anatomical Association Conference 2022

Committee member, Malaysian Anatomical Association

Dean of Biomedical Sciences, NUMed Malaysia



On behalf of the organising committee, I warmly welcome you to the **2nd Malaysian Anatomical Association Conference (MAAC) 2022** in the beautiful Iskandar Puteri city of Johor, Malaysia. The long-awaited conference after our first successful MAAC 2019 will be held on the **2nd and 3rd of November 2022**.

We have chosen the conference theme '**Anatomy in the New Norms: Tracing New Trajectory in Teaching and Research**' to reflect the highly relevant aspect to discuss in the light of the current situation and the reality that we are facing since the world has to face the Covid-19 pandemic. This is **our first hybrid conference**, and we hope that we could give you the best opportunities to be part of the wider anatomy community despite the challenges that we face with the pandemic. The pandemic can no longer stop us from reaching out and creating impacts to all corners of the globe, so we hope to offer participants the privilege of virtual conference if your circumstances do not allow you to join us physically. This conference will be one for us to share our thoughts and exchange ideas on how to chart our journey forward to reach the new heights.

MAAC 2022 will once again welcome fellow anatomists and researchers to share a wide spectrum of research topics which include cell biology, neuroscience, developmental biology, clinical anatomy, forensic anatomy, anatomy education, anthropology and applied anatomy. We hope that all participants will be able to extend the network, and engage with the sessions in full excitement and gained as much as possible from this event. I would like to thank **Professor Dr. Norzana Abd Ghafar**, our previous MAAC 2019 chairperson for providing her wisdom and guidance as an Advisor for MAAC 2022, all our international and local speakers and the committee members who have been working really hard to ensure the success of MAAC 2022. I would also like to thank all of the sponsoring organizations for their generous financial support and finally, to all of you, our conference participants who really made everything that we have planned in MAAC 2022 '**A Dream Comes True**'.

Selamat datang!

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Advisor: Prof. Dr. Norzana Abd Ghafar (UKM)

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Programme Schedule

Day 1, Wednesday, 2 nd November 2022	
8.00 – 9.00am	Registration
9.00 – 9.30am	OPENING CEREMONY Welcome Speech by Assoc. Prof Dr. Madihah Rushaidi (Chairperson of MAAC) Officiating ceremony by Prof. Dr. Norzana Abd Ghafar (MAA Advisor) & Dr Paul Hubbard (NUMed Associate Dean of Academic Affairs)
9.30 – 10.30am	KEYNOTE Title: Expanding the Horizon in Anatomy during Covid-19 Pandemic/Endemic Speaker: Prof. Dr. Nalini Pather (University New South Wales, Sydney Australia) Chairperson: Assoc. Prof. Dr. Siti Nurma Hanim Hadie
10.30 – 10.45am	Group photo session Refreshment
10.45 – 11.30am	PLENARY 1 Title: Mapping the Trajectory in Anatomy Research during Covid-19 Pandemic Speaker: Assoc. Prof. Dr. Cheah Pike See (Universiti Putra Malaysia) Chairperson: Assoc. Prof. Dr. Elvy Suhana Mohd Ramli
11.30 – 12.30pm	Oral presentation 1 (Developmental Anatomy/Biology & Clinical Anatomy) Chairperson: Dr. Mohd Yusof Mohamad Judges: Prof. Dr. Norzana Abd Ghafar (Universiti Kebangsaan Malaysia) Assoc. Prof. Dr. Cheah Pike See (Universiti Putra Malaysia)
11.30 – 11.40am	O201 - Evaluation of Remyelinating Effects of Alpha-Tocopherol Compared to Fingolimod in Cuprizone-Induced Rat Model of Multiple Sclerosis Prof. Dr. Nilesh Kumar Mitra (International Medical University)
11.40 – 11.50am	O401 - Stereological Analysis of Heart Ventricles During the Development of Osteoarthritis in Dunkin Hartley Guinea Pigs Nur Amani Hanis Roseman (International Islamic University Malaysia)
11.50 – 12.00pm	O404 - A Review on Non-Vascularised Periosteal Graft Transplantation: A Promising Approach in Bone Healing Management Azeez Omoniyi Adeoye (Universiti Sains Malaysia)
12.00 – 12.10pm	V202 - Nitric Oxide Inhibitory Activity of <i>Kappaphycus Alvarezii</i> in LPS-Stimulated BV2 Microglia Nicole Lai Jean-Yean (Sunway University)
12.10 – 12.20pm	V204 - Inflammatory and Dopaminergic Abnormalities in Prefrontal Cortex at 12-Months Following Different Severities of Traumatic Brain Injury Ing Chee Wee (University of Adelaide, Australia)
12.20 – 12.30pm	V406 - Aberrant Vasculature of Head and Neck in Carotid Triangle: Clinical Implications Dr. Khusru Nomani (All India Institute of Medical Sciences, India)
12.30 – 1.10pm	Sponsor talk: Elsevier

Programme Schedule

Day 1, Wednesday, 2 nd November 2022	
1.10 – 2.30pm	Lunch & prayer
2.30 – 3.00pm	SYMPOSIUM 1 (Theme: Neuroanatomy) Title: The Role of Metallothionein in Parkinson's Disease and Traumatic Brain Injury Models of Zebrafish Speaker: Assoc. Prof. Dr. Teoh Seong Lin (Universiti Kebangsaan Malaysia) Chairperson: Dr Razif Abas
3.00 – 3.15pm	Sponsor talk: Modiezam Sdn. Bhd.
3.15 – 3.30pm	Sponsor talk: InteDashboard
3.30 – 5.00pm	Oral presentation 2 (Anatomy Education) Chairperson: Mrs Norhazilah Muhamad Judges: Prof. Dr. Nalini Pather (University New South Wales, Australia) Dr. Iain D. Keenan (Newcastle University, United Kingdom)
3.30 – 3.40pm	O506 - Persuasive Gamify Problem-Based Learning in Medical Curriculum: A Promising and Engaging Approach for Learning Clinical Applied Anatomy Dr. Azril Shahreez Abdul Ghani (Universiti Sains Malaysia)
3.40 – 3.50pm	O530 - Is Human Retina a Poorly Designed Structure? Analysis Between Creationist and Evolutionist View Dr. Mohd Yusof Mohamad (International Islamic University Malaysia)
3.50 – 4.00pm	O507 - The Design and Development of Work-Based Surface Anatomy Teaching (WSAT) Framework Dr. Yasrul Izad Abu Bakar (Universiti Sains Malaysia)
4.00 – 4.10pm	O508 - Clinical Year Students' Reflection on Anatomy Learning Experience: A Keystone to Developing an Integrated Preclinical Anatomy Teaching Dr. Syarifah Aisyah Syed Abd Halim (Universiti Kebangsaan Malaysia)
4.10 – 4.20pm	O523 - Improving Anatomy Learning for First Year Dentistry Students Using Online Quizzes and Personalised Learning Methods Dr. Intan Suhana Zulkafli (Universiti Malaya)
4.20 – 4.30pm	O533 - Impact of Covid-19 Towards the Outcome of Anatomy Practical Assessment in the Universiti Malaya Medical Program (UMMP) Assoc. Prof. Dr. Rosie Pamela David (Universiti Malaya)
4.30 – 4.40pm	V509 - Threshold Concepts in Clinical Anatomy Education Dr. Vivek Perumal (Nanyang Technological University, Singapore)
4.40 – 4.50pm	V532 - The Need for Analysis of Anatomy Content for the Training of Traditional Malay Practitioners Dr. Husnaida Abdul Manan@Sulong (Universiti Sains Malaysia)
5.00 – 5.30pm	Refreshment
8.00pm	Banquet dinner at JEN Puteri Iskandar Skybar Restaurant

Programme Schedule

Day 2, Thursday, 3 rd November 2022	
9.00 – 9.45am	PLENARY 2 Title: Anatomy Education Future Scenario: Practical Revolution and Beyond Speaker: Assoc. Prof. Dr. Lakshmi Selvaratnam (Monash University, Malaysia) Chairperson: Dr. Choy Ker Woon
9.45 – 10.45am	Oral presentation 3 (Cell Biology & Applied Anatomy) Chairperson: Dr. Dante Fernandez Judges: Assoc. Prof. Dr. Lakshmi Selvaratnam (Monash University) Dr. Razif Abas (Universiti Putra Malaysia)
9.45 – 9.55am	O101 - Cytoprotective Effects of <i>Lignosus rhinocerotis</i> Against L-Buthionine-Sulfoximine-Induced Oxidative Damage in Friedreich's Ataxia Fibroblasts Michael Weng Lok Phang (Universiti Malaya)
9.55 – 10.05am	O103 - Hyaluronic Acid/Collagen Hydrogel to Mimic Nucleus Pulposus Microenvironment: An Implication for the Stem Cell Transplantation in Intervertebral Disc Dr. Isma Liza Mohd Isa (Universiti Kebangsaan Malaysia)
10.05 – 10.15am	O106 - The Assessment of Interleukin-10 and Periodontal Parameters in Chronic Kidney Disease Patients with Inflammation of the Gum and Tooth-Supporting Tissues Following Periodontal Therapy Dr. Nur Karyatee Kassim (Universiti Sains Malaysia)
10.15 – 10.25am	O109 - Low Dose Gelam Honey Promotes Human Corneal Epithelial Cells (hTCEpi) Proliferation Dr. Nahdia Afifah Abdul Jalil (Universiti Kebangsaan Malaysia)
10.25 – 10.35am	O110 - Mitochondria-Targeted Compounds Derived from <i>Hericium Erinaceus</i> as Possible Therapeutics in Friedreich's Ataxia Dr. Wong Kah Hui (Universiti Malaya)
10.35 – 10.45am	V802 - Best Practice for Stereological Quantifying the Microscopic Structure of Mouse Liver Dr. Mohd Hairulhisyam Ngatiman (Universiti Sains Islam Malaysia)
10.45 – 11.00am	Refreshment
11.00 – 11.30am	SYMPOSIUM 2 (Theme: Forensic Anatomy) Title: Application of Anatomy through the Lens of Forensic Science Speaker: Professor. Dr. Faridah Mohd Nor (Universiti Kebangsaan Malaysia) Chairperson: Dr. Zaitunnatakhin Zamli

Programme Schedule

Day 2, Thursday, 3 rd November 2022	
11.30 – 12.30pm	Oral presentation 4 (Forensic Anatomy, Anthropology & Applied Anatomy) Chairperson: Dr. Norhida Ramli Judges: Prof. Dr. Faridah Mohd Nor (Universiti Kebangsaan Malaysia) Dr. Choy Ker Woon (Universiti Teknologi MARA)
11.30 – 11.40am	O702 - Palmaris Longus Muscle Agenesis in Banjarese People in South Kalimantan Indonesia Dr. Oski Iliandri (Lambung Mangkurat University, Indonesia)
11.40 – 11.50am	O805 - The Impact of Robotic Rehabilitation on Mid-Thigh and Mid-Calf Circumferences and Functional Outcomes of Stroke Patients Dr. Nur Fasihah Mat Nawi (Universiti Sains Malaysia)
11.50 – 12.00pm	V601 - Forensic Craniofacial Superimposition: Comparison of Real-World and Digital Approaches Dr. Helmi Mohd Hadi Pritam (Universiti Sains Malaysia)
12.00 – 12.10pm	V602 - Shape Variation of Mandibular Anatomy in The Malaysian Population by CT scan: A Geometric Morphometric Method for Identification of Ancestry Dr. Aspalilah Alias (Universiti Sains Islam Malaysia)
12.10 – 12.20pm	V703 - Hand Anthropometry: Baseline Data of the Major Ethnic Groups in Sabah Hasanur bin Khazri (Universiti Malaysia Sabah)
12.20 – 12.30pm	V704 - Geometric Morphometric Study of the First Lumbar Vertebra for Sex Assessment in the Malaysian Population Afiana Rohmani (Universiti Kebangsaan Malaysia)
12.30 – 1.10pm	Sponsor Talk: Markora System (M) Sdn. Bhd
1.10 – 2.30pm	Lunch & prayer
2.30 – 2.50pm	E-poster slide show (Rapid Fire finalists)
2.50 – 4.00pm	Rapid Fire Session Chairperson: Mrs. Rani Sakaran (AIMST)
4.00 – 4.30pm	SYMPOSIUM 3 (Theme: Anatomy Education) Title: Exploring 3D Anatomy Speaker: Dr Iain D. Keenan (Newcastle University, United Kingdom) Chairperson: Assoc. Prof Dr. Madinah Rushaidhi
4.30 – 5.00pm	Award Presentation
	CLOSING CEREMONY Closing speech by Assoc. Prof. Dr. Siti Nurma Hanim Hadie (President of MAA) Video presentation
5.00 – 5.30pm	Refreshment

List of Poster Presentation

ID	TITLE & NAME OF PRESENTER
P102	Physicochemical Properties of Dehydrated and Raw Stingless Bee Honey <i>Dr. Liyana Nabihah binti Ikhsan (Universiti Kebangsaan Malaysia)</i>
P104	Bioactive Compounds Of Dehydrated and Raw Stingless Bee Honey <i>Dr. Fairus Ahmad (Universiti Kebangsaan Malaysia)</i>
P105	Protective Effects of Tualang Honey Supplementation on the Prefrontal Cortex Following Chronic Stress Exposure in Rat Model <i>Dr. Faizah Md Nawi (Universiti Sains Malaysia)</i>
P107	Isolation of Adipose Derived Stem Cells from Adipose Tissue of Rat: A Pilot Study <i>Sun QingNing (Universiti Sains Malaysia)</i>
P108	Elucidating Vascular Protective Effect of Thymoquinone in Homocysteine- Induced Endothelial Dysfunction: In Vitro and Ex Vivo Model <i>Dr. Choy Ker Woon (University Teknologi MARA)</i>
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Biodata of Speakers



Keynote speaker

Professor Dr. Nalini Pather
(University New South Wales, Australia)

Professor Dr. Nalini Pather is the Associate Dean Education Innovation at UNSW Australia, Chair of the IFAA's International Federative Program for Anatomical Education (FIPAE), and Associate Editor of the journal, Anatomical Sciences Education. At UNSW, she currently co-leads the redesign of the medicine program. Nalini's research focusses on anatomical imaging and radiomics for the development of early diagnostic systems, immersive technologies and education such as digital learning, AR/VR and 3D printing, and inclusive education design. Nalini is a Fellow of the Australian and New Zealand Association of Health Professional Educators (ANZAHPE) and the UNSW Scientia Education Academy (SEA).

Having completed a PhD in the cell biology of wound healing and management, and a Masters in clinical anatomy and imaging, Nalini has developed expertise in a wide range of techniques (ranging from 3D modelling and printing, to novel cell biology techniques). These skills enable her to interrogate advances in medical technologies to enable translation to medical and education practice, and science communication and advocacy. Nalini is currently supervising five HDR students.

Nalini has more than 25 years' experience in design and implementation of educational innovation in medicine and health science programs in several countries. Nalini currently teaches into the UNSW Medicine programme as well as to Exercise Physiology, Biomedical Engineering and Medical Science students. She has won several awards (Faculty, Vice-Chancellor, Australian OLT citation awards) for her contributions to higher education.

Plenary 1 speaker

Assoc. Prof. Dr. Cheah Pike See
(Universiti Putra Malaysia)



Assoc. Prof. Dr. Cheah Pike See is an Anatomist and Neuroscientist with her research focus to identify and to understand the function of causative genes for neurodevelopmental disorders and neuropsychiatric diseases. Her postdoctoral training in University of Adelaide (Australia) and Massachusetts General Hospital / Harvard Medical School (USA) has broadened her research experience in various fields including stroke, cancer biology, and gene therapy.

As an active member of Malaysian Society of Neurosciences (MSN), Young Scientist Network-Academy of Sciences Malaysia (YSN-ASM) and, recently as the Chair of the International Brain Research Organization-Asia Pacific Research Committee (IBRO-APRC), she helps to promote collaborative networks between clinical and non-clinical neuroscientists as well as to improve the quality of the neuroscience research in Malaysia and internationally. Dr. Cheah also wishes to materialise the dream of effective translation from bench to bedside and ultimately, to extend her role by reaching out to the society to disseminate knowledge on the relevance of her research for better management and treatment of neurological disorders.

Biodata of Speakers



Plenary 2 speaker

Assoc. Prof. Dr. Lakshmi Selvaratnam
(Monash University, Malaysia)

Assoc. Prof. Dr. Lakshmi Selvaratnam has served as a clinical anatomist and medical educator in UK and Malaysian universities (UM and Monash Malaysia) since 1991. She has a background in hospital dental surgery and PhD in tissue engineering, As a foundation Anatomy Coordinator for Monash's new Medical School, she was instrumental in developing a non-dissection clinical anatomy curriculum and in establishing the futuristic Medical Anatomy & Pathology E-Learning (MAPEL) Lab; with multi-award-winning networked ecosystem of teacher and student collaborative Smart Tables (MyIP). Her research has focused on technology-enhanced practical learning, active learning, remote skills training, mixed reality and medical imaging applications. She co-authored a popular anatomy text/ workbook series and served as reviewer for Gray's Anatomy (39e). She enthusiastically advocates healthcare educator development (MAEMHS Exco), postgraduate surgical training in anatomy (AcadMed Malaysia) and art-science initiatives in health education (ASM ArtSci Committee). Dr. Selvaratnam champions technology-supported collaborative active learning as the future forward in anatomy and healthcare education.

Symposium 1 speaker

Assoc. Prof. Dr. Teoh Seong Lin
(Universiti Kebangsaan Malaysia)



Assoc. Prof. Dr. Teoh is currently an academic staff in the Department of Anatomy, Universiti Kebangsaan Malaysia. He obtained his B.Biomed.Sc (Hons) and M.Med.Sc (Anat) from UKM, and conferred a PhD (Neuroscience) from Monash University Malaysia. His research interest falls into the neuroregeneration and neurodegeneration processes in the brain, in particular, the brain of zebrafish. His work aims to decipher the differential neuroregeneration mechanism in the zebrafish in search of new treatment strategies for neurodegenerative diseases and brain injuries clinically. In 2021, he has awarded the Young researcher award from the Faculty of Medicine, UKM. In the same year, he was also listed in the Top 2% scientist for single year (2020) impact, which was released by Stanford University.

Biodata of Speakers



Symposium 2 speaker

Professor. Dr. Faridah Mohd Nor
(Universiti Kebangsaan Malaysia)

Dr. Faridah Mohd Nor is a professor of forensic with subspecialization in forensic anthropology. She graduated with Medical Degree and received her Master in Forensic Pathology from the Universiti Kebangsaan Malaysia. She received her PhD from the University of Bradford with postdoctoral fellowship from the University of Oregon. She is currently working as a consultant at the Forensic Unit, Medical Faculty, Universiti Kebangsaan Malaysia. As a highly valued researcher, she has been commended as the second highest publication category award individual 2020. She had received numerous awards and gold medals in international and national conferences. She is currently part of the forensic specialty subcommittee member in the National Specialist Registry and a member in the Academy of Medicine of Malaysia with a strong link with the police and law enforcement officials in Malaysia. She had recently involved in the investigation of a forensic case with the Netherland forensic expert and police.

Symposium 3 speaker

Dr Iain D. Keenan
(Newcastle University, United Kingdom)



Dr. Iain D. Keenan is a Senior Lecturer in Anatomy in the School of Medical Education (SME), Newcastle University and is an Advance HE National Teaching Fellow. He leads anatomy and embryology teaching for undergraduate, graduate-entry and postgraduate medical and medical sciences degree programmes. He leads a research programme and supervises a PhD project in anatomy education. His research concerns implementing student partner approaches for the strategic design, evaluation and curricular implementation of innovative and creative technology-enhanced 3D learning approaches. He has introduced a number of teaching and curricular innovations since joining the School of Medical Education in 2012. These approaches include art-based learning, 3D digital learning technologies, 3D printing, and social media. Iain was awarded a National Teaching Fellowship from Advance HE in 2020 for his educational frameworks, evidence-based learning approaches, student-partnerships and commitment to global open-access communication.

Abstract (Keynote)

EXPANDING THE HORIZON IN ANATOMY DURING COVID19 PANDEMIC/ENDEMIC

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Students, practicing physicians, and patients rightly place high value on the importance of anatomy to medical and health practice. Yet there remains considerable controversy on the place and significance of anatomy in medical programs. The pandemic has challenged long held dogmas about anatomy. What does the future hold for the discipline, and what is its role in 21st century medicine and health education and practice? The answer to this question lies fundamentally in our notion of what kind of doctor and health professional are we seeking to train. What is a good doctor? What is a good physiotherapist, pharmacist? The answer depends on who you ask. Anatomy extends beyond names, labels and descriptions. Anatomy has broadened its remit to include professional competencies such as self-awareness, reflective practice, teamwork, empathy and medical ethics. Indeed, the discipline finds itself more cognizant of the broad range of topics that impact, shape, and influence medical and health education, health care in the 21st century, and the changing society and culture around us. Anatomy is also the unique nexus to advance technological innovations that will profoundly change medical practice, and that is contributing to the discipline being reimagined. Medicine is evolving with giant leaps. Engagement with technology has sparked new interest in the discipline as its technologies and teaching approaches become more relevant to health delivery at the bedside. This presentation will reflect on the emerging trends in anatomy education and suggest a future direction for the discipline.

Abstract (Plenary 1)

MAPPING THE TRAJECTORY IN ANATOMY RESEARCH DURING COVID-19 PANDEMIC

Cheah Pike See

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Anatomy is a classic but fascinating branch of biology, as it takes a unified approach to other subjects, covering Gross Anatomy, Histology, Embryology and Neuroanatomy. The COVID-19 pandemic situation has posed unprecedented challenges to anatomy teaching and has changed modern medical education forever. Anatomists have succeeded in adapting their teaching to online delivery within a short stretch of time. The instantaneous impact of the cessation of person-to-person anatomical teaching has accompanied ethical uncertainties for this humanistic discipline. The emergence of COVID-19 has forced anatomists to relook at anatomy education and research with a fresh lens. It allowed us to transgress familiar boundaries and explore novel teaching, learning and research spaces in many ways. The nationwide lockdowns and movement controls had restricted the laboratory personnel to access the research facilities. It also severely disrupted the performance of strong research-oriented institutions. In this plenary session, I will also share how we realigned the research strategic directions of the neuroanatomical-centred research during this harrowing period of the Covid-19 pandemic. The expectation is that hybrid mode of teaching, intense utilization of educational technologies (digitized cadaveric resources, virtual anatomy museum, digital brain research infrastructure) and active pedagogy strategies will be undertaken in the future trajectory for anatomy. Anatomy will continue to flourish and emerge as an exciting and demanding discipline if there is a harmonized way to expand the traditional horizons to integrate all that is best in the face-to-face contact sessions and digital worlds.

ANATOMY EDUCATION FUTURE SCENARIOS: PRACTICAL REVOLUTION & BEYOND

Lakshmi Selvaratnam

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Healthcare education, and hence anatomy education too, is having to play catch up with the phenomenal transformations brought about by medical technology that are taking place in the healthcare workplace. Accepting these rapid changes in teaching and learning of anatomy have been triggered and fast-forwarded by the Covid-19 pandemic. If anatomy, as a key discipline in medicine, is to remain relevant in healthcare education for the foreseeable future, then anatomists must remain relevant and must be prepared to embrace change. Medical technology has revolutionised clinical practice at such a remarkable rate that if healthcare professionals fail to stay updated, they will be left behind or worse, patient safety may be impacted. Healthcare systems are increasingly reliant on a range of digital health technologies with the pandemic providing the ultimate test bed for many of them. So, healthcare students including those studying anatomy should be exposed to some medical technology early on during their experiential learning and within their institutions, wherever possible. Furthermore, technology-supported learning environments can play a vital role in enhancing anatomy education through active collaborative practical learning when faced with large student cohorts and limited tutor experts (Smith et al, 2021). Integration of digital tools such as mixed reality (AR/VR) with 3D models/medical imaging learning resources allow for immersive simulation experiences as an adjunct to hands on exposure to anatomy models, human specimens and ultimately live patients. Our team's experiences with a technology-integrated anatomy lab and embedded educational technologies designed to engage medical student learning are highlighted. Futureproofing scenarios for anatomy education are discussed – if we want to stay relevant, we must join the practical revolution or perish!

THE ROLE OF METALLOTHIONEIN IN PARKINSON'S DISEASE AND TRAUMATIC BRAIN INJURY MODELS OF ZEBRAFISH

Teoh Seong Lin

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Introduction: Metallothionein (MT) is a protein known to be involved in several important processes such as essential metal homeostasis, heavy metal detoxification, inflammation, and antioxidative stress. In view of these properties, MT may serve as a potential therapeutic approach in mitigating oxidative stress-induced neurodegeneration in the brain, i.e., Parkinson disease and traumatic brain injury.

Methods: Adult zebrafish received intraperitoneal injection of 20 mg/kg bw paraquat dichloride hydrate treatment to induced dopaminergic neuronal death, while stab wound injury was induced by using a 30G syringe to the left telencephalon. Fishes received intracranial injection of 0.2 µg/fish human full-length human metallothionein 2 peptide (hMT2) as a neuroprotective agent.

Results: Paraquat treatment led to a reduction of dopaminergic neurons, down-regulated the expression of genes related to dopamine activity and biosynthesis (*dat* and *th1*), and up-regulated proinflammatory genes expression (*il-1α*, *il-1β*, *tnf-α* and *cox-2*). hMT2 treatment was able to reverse the effects of paraquat. hMT2 treatment also lead to the increased number of proliferating cells and decreased apoptotic cells in the traumatic brain injury model.

Conclusion: Exposure to paraquat is known to cause loss of dopaminergic neurons. Our results suggest the neuroprotective effect of exogenous treatment of hMT2 in response to brain injury.

APPLICATION OF ANATOMY THROUGH THE LENS OF FORENSIC SCIENCE

Faridah Mohd Nor

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Anatomical Sciences are important in medical and forensic education and investigations. Areas of Anatomical Sciences which are important in forensic education and investigations will be highlighted and discussed. Hence, there is need for collaboration among Anatomist who are interested in forensic education and investigations with other Forensic Scientists. This collaboration will create opportunity for exchange of ideas required for proper investigations in Forensics as well as employment opportunity. The branches of anatomy that are important for forensic science investigations include embryology in fingerprinting, footprints and other body prints such as ear prints and lip prints, biometry of these prints in the form of pattern recognition of a human suspect and osteology through osteometric and somatometric evaluation of bones for identification purposes. Thus, anatomical sciences are vital in Forensic Science/education and investigations, and Anatomists who are interested in Forensics should be allowed to participate. This will ultimately create opportunity and collaboration among Anatomists and other Forensic Scientists for exchange of ideas and for proper investigations having highlighted areas, where Anatomical Sciences are important in Forensic science/investigation.

Abstract (Symposium 3)

EXPLORING 3D ANATOMY

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In recent years, the development and introduction of three-dimensional digital learning technologies has improved the provision of learning resources in anatomy education. The recent emergence of Covid-19 has resulted in widespread technological challenges for educators and learners, and has raised pedagogic, logistical, and ethical concerns. Nonetheless, the pandemic has also produced favourable conditions for the creation of valuable strategies for the learning and teaching of anatomy, and for developing and modernising universal approaches to remote anatomy education. To address pandemic-era challenges within the contemporary pedagogic landscape, it has been essential to explore case studies, educator reflections, and research-informed solutions with respect to blended anatomy curricula and technology-enhanced adaptations. Identifying insights, impacts, successes, and limitations of a range of interventions, and providing record of the unprecedented contemporary circumstances, can support the development of ongoing strategies for delivering blended anatomy curricula and futureproofing anatomical education practice. We have implemented our own student-partnership approach for evaluating, adapting, and integrating effective blended learning strategies. Examples include our synchronous multimodal approach for supporting spatial understanding and clinical image interpretation through combining anatomy visualisation tables and 3D printed models; our art-based gross anatomy and surface anatomy activities for supporting knowledge acquisition and spatial observational skills; our asynchronous delivery of accessible digital tools for remote study of gross anatomy, imaging, embryology, and histology; and our 'Exploring 3D Anatomy' massive open online course. Our work has implications for anatomy educators seeking to integrate innovative, engaging, and effective strategies for transforming student learning within modern blended anatomy curricula.

0101

CYTOPROTECTIVE EFFECTS OF *LIGNOSUS RHINOCEROTIS* AGAINST L-BUTHIONINE-SULFOXIMINE-INDUCED OXIDATIVE DAMAGE IN FRIEDREICH'S ATAXIA FIBROBLASTS

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Introduction: Friedreich's ataxia (FRDA) is an autosomal recessive genetic disorder caused by mutations of the frataxin (FXN) gene. There is currently no cure for the debilitating disease. *Lignosus rhinocerotis*, a medicinal mushroom has been demonstrated to treat variety of illnesses among the *indigenous* communities in *Southeast Asia*. We aim to explore the cytoprotective effects of *L. rhinocerotis* against L-Buthionine-sulfoximine (L-BSO)-induced oxidative damage in a cellular model of FRDA.

Methods: A dried sample of *L. rhinocerotis* was subjected to sequential extraction. Ethanol extract was evaluated for its phytochemical contents and *in vitro* antioxidant activities and analysed by liquid chromatography-mass spectrometry (LC-MS). Cytoprotective effects of the extract against oxidative damage were conducted in fibroblasts derived from FRDA patients and the activities were compared to idebenone.

Results and Discussion: Upon incubation with 12 mM L-BSO, the viability of FRDA fibroblasts was significantly reduced to 53% compared to negative control ($p < 0.05$). Pre-incubation with ethanol extract in the range of 15.63 to 62.5 µg/mL increased the viability to 95 to 114%, and prevented the deterioration of membrane integrity, nuclear apoptosis, intracellular reactive oxygen species (ROS) production and superoxide dismutase (SOD) deficiency, therefore contributing to restoration of mitochondrial function. The cytoprotective effects could be attributed to the exogenous antioxidants and compounds found in the ethanol extract, namely D-sorbitol, 5,8,12-trihydroxy-9-octadecenoic acid, α-9(10)-EpODE, palmitoleamide and linoleamide.

Conclusion: *L. rhinocerotis*-derived exogenous antioxidants and potential compounds can attenuate oxidative damage and boost the endogenous antioxidant defense system in FRDA fibroblasts.

0103

HYALURONIC ACID/COLLAGEN HYDROGEL TO MIMIC NUCLEUS PULPOSUS MICROENVIRONMENT: AN IMPLICATION FOR THE STEM CELL TRANSPLANTATION IN INTERVERTEBRAL DISC

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Introduction: The use of extracellular matrix-based biomaterials in tissue engineering offers an effective approach to mimicking the disc microenvironment and supporting stem cell transplantation for tissue regeneration. Nevertheless, little is known about the preconditioning of human Wharton Jelly-derived mesenchymal stem cells (MSCs) on hydrogel towards the nucleus pulposus (NP) phenotype and modulation of pain in intervertebral disc degeneration.

Methods: We formulated a 3D type II collagen (COLII) hydrogel enriched with hyaluronic acid (HA) at various weight ratios of HA:COLII, 1:9 and 4.5:9. We characterised hydrogel for stability, degradation and swelling properties. *In vitro*, we assessed the cell viability, morphology, and NP phenotypic markers on MSC-encapsulated hydrogel. *In vivo*, we implanted the hydrogel in a surgically induced disc injury model of pain in the rat tail over 28 days. We assessed the body weight for general health status and nociceptive behaviour for mechanical allodynia using the von Frey test in rats. ($p < 0.05$, two-way ANOVA, $n = 3$)

Results: All hydrogel formulations were hydrolytically stable over 36 days and had a similar enzymatic degradation profile. The 4.5:9 HA/COLII hydrogel exhibited a significantly higher swelling property than the 1:9 HA/COLII hydrogel. We observed higher cell viability with a round morphology shape of the cell-encapsulated hydrogel. *In vivo*, we revealed that disc injury evoked mechanical allodynia in rats but was suppressed in the hydrogel-treated group.

Conclusion: The tuneable hydrogel mimics the 3D NP microenvironment in guiding stem cells toward NP-like cells. Our results suggest that hydrogel could support stem cell transplantation for disc regeneration targeting pain.

0106

THE ASSESSMENT OF INTERLEUKIN-10 AND PERIODONTAL PARAMETERS IN CHRONIC KIDNEY DISEASE PATIENTS WITH INFLAMMATION OF THE GUM AND TOOTH-SUPPORTING TISSUES FOLLOWING PERIODONTAL THERAPY

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Introduction: Chronic kidney disease (CKD) is characterized by kidney structure and function abnormalities. CKD also includes permanent nephron loss and a decline in glomerular filtration rate. Most CKD patients have periodontitis, a chronic inflammatory disease of the gums and tooth-supporting tissues. Periodontitis is linked to CKD due to the hyper-inflammatory state in both conditions. Interleukin-10 (IL-10) is an inflammatory marker with immunomodulatory properties influencing the host's immune responses. Little is known regarding the effect of periodontal therapy on inflammatory markers and periodontal parameters in CKD patients with periodontitis. Therefore, this study aimed to compare the levels of IL-10 and periodontal parameters before and after receiving periodontal therapy.

Methods: Twenty CKD patients with periodontitis (Group 1) and twenty non-CKD patients with periodontitis (Group 2) participated in this study. A blood sample was collected during each visit. Serum IL-10 concentration was analysed using an enzyme-linked immunosorbent assay. The periodontal parameters such as periodontal probing depth, clinical attachment loss, gingival bleeding index and plaque score were also measured.

Results: Our findings revealed that IL-10 level was significantly higher ($p < 0.05$) in Group 1 [Mean (SD) = 1.301(0.29)pg/ml] than in Group 2 [Mean (SD)= 0.81(0.27)pg/ml]. Following periodontal therapy, there was a significant reduction ($p < 0.05$) in IL-10 levels and periodontal parameters in both groups.

Conclusion: Periodontal therapy has shown improvement in both inflammatory markers and periodontal parameters. IL-10 is a promising inflammatory marker for monitoring the progression of CKD. Therefore, multicentre and larger sample size studies are needed in the future.

0109

LOW DOSE GELAM HONEY PROMOTES HUMAN CORNEAL EPITHELIAL CELLS (hTCEpi) PROLIFERATION

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Introduction: Proliferation is one of the vital phases in wound healing whereby cells divide and replace the wounded area. Data supporting the efficacy of honey to hasten epidermal wound healing is well established. However, its healing effect on corneal epithelial cells (CECs) injury is limited. This study aimed to evaluate the effect of gelam honey (GH) on the proliferation of in vitro human corneal epithelium (hTCEpi) cells.

Methods: hTCEpi cells were grown in keratinocyte growth medium (KGM) at a density 5×10^3 cells/cm² and incubated for 24 hours at 37°C in a humidified 5% CO₂. The media were then changed into KGM enriched GH concentration ranging from 0% to 6.25% on the following day. The optimal dose of GH for hTCEpi cells viability were analysed via MTT assay. The effect of GH on the hTCEpi morphology was evaluated using phase-contrast inverted microscope.

Results: The effect of GH on the viability of hTCEpi cells was dose-dependent. Increasing doses of GH gradually improved the viability of hTCEpi cells and peaked at 0.0061% ($p < 0.05$) before the viability began to decline at 0.0244%. At 6.25% concentration, proliferation of hTCEpi cells was reduced to only 40% ($p < 0.05$). Microscopic evaluation revealed hTCEpi cells maintained phenotypic characteristics of CECs after GH treatment.

Conclusion: Low dose GH stimulated the proliferation of hTCEpi cells, which would implicate its role in promoting corneal wound healing. In contrast, high dose hindered hTCEpi cells proliferation. GH was also safe and non-toxic to the viability of hTCEpi cells.

0110

MITOCHONDRIA-TARGETED COMPOUNDS DERIVED FROM *HERICIUM ERINACEUS* AS POSSIBLE THERAPEUTICS IN FRIEDREICH'S ATAXIA

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Introduction: Friedreich's ataxia (FRDA) is an *autosomal recessive* disorder associated with defective mitochondrial *iron* homeostasis. *Hericium erinaceus*, a culinary and medicinal mushroom has been shown to counteract the deleterious effects of free radicals. We investigated the impact of iron accumulation on cellular homeostasis and the mechanism by which *H. erinaceus* may be acting to restore mitochondrial function in FRDA.

Methods: A dietary supplement derived from *H. erinaceus* (HESE) governed by Trade Marks Act 1976 was obtained from Ganofarm R&D Sdn. Bhd. HESE was separated into fractions using chromatographic methods and the compounds were identified using spectroscopic methods. HESE and its major compounds were evaluated for protective effects against oxidative stress, as well as regulation of mitochondrial function and biogenesis in fibroblasts derived from a FRDA patient.

Results: Adenosine, herierins III and IV were identified as major compounds. Following exposure to L-buthionine sulfoximine (BSO), we observed reduced endogenous antioxidant enzyme activities, increased intracellular reactive oxygen species (ROS) and apoptosis in FRDA fibroblasts. Interestingly, HESE and its major compounds enhanced mitochondrial metabolism by regulating mitochondrial DNA transcription and translation, a complex coordinated process involving Tfam (transcription factor A) activated by mitochondrial biogenesis-associated transcription factors, namely, NRF1 and NRF2 (nuclear respiratory factor 1 and 2). Reconstruction of mitochondrial function contributes to the maintenance of cellular integrity through the restoration of antioxidant defense mechanisms of superoxide dismutase and catalase, restoration of plasma membrane integrity, and suppression of ROS accumulation.

Conclusion: Mitochondria-targeted compounds regulating cellular antioxidant defence could be considered for the management of FRDA.

0201

EVALUATION OF REMYELINATING EFFECTS OF ALPHA-TOCOPHEROL COMPARED TO FINGOLIMOD IN CUPRIZONE-INDUCED RAT MODEL OF MULTIPLE SCLEROSIS

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Introduction: Oxidative stress has been involved in the pathogenesis of multiple sclerosis (MS). The mainstay of treatment of MS has been symptomatic. Hence the development of therapies that promote remyelination is needed. This study investigates demyelination following cuprizone treatment and compares remyelinating properties of alpha-tocopherol with fingolimod during withdrawal of cuprizone, using open-field-test (OFT) and histological analysis.

Methods: Female Sprague-Dawley rats (8 weeks) of 3 groups (n=10) were fed with cuprizone diet week 1 to week 5. During week 6-7, groups received IP injections treatment withdrawn from cuprizone. Control group C: vehicle 10% ethanol in saline. Treatment group A: 100mg/kg dl-alpha-tocopherol acetate; group F: 0.3mg/kg Fingolimod HCl. OFT and beam walking test (BWT) were done every 10 days. Following euthanasia, the white matter in cerebellum and corpus callosum were stained with Luxol fast blue (LFB) for mean area of demyelination and IHC for myelin basic protein (MBP) expression. Data from OFT, BWT and mean area of demyelination were analyzed using One-way ANOVA.

Results: The average speed and frequency of line crossing increased significantly in week 6-7, in group A compared to group F (P<0.05) and group C (P<0.05). The mean time to traverse 80 cm beam in BWT was reduced by 52% in group A, compared to similar reduction of 28% in group F. Mean area of demyelination reduced significantly in corpus callosum (P<0.05) in group A compared to group F and group C. Increased MBP expression in IHC was observed in group A compared to group F.

Conclusion: This study showed alpha-tocopherol is able to promote remyelination better than fingolimod in MS.

V202

NITRIC OXIDE INHIBITORY ACTIVITY OF *KAPPAPHYCUS ALVAREZII* IN LPS-STIMULATED BV2 MICROGLIA

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Introduction: Activated microglia and astrocytes will set off neuroinflammation by activating pro-inflammatory factors such as nitric oxide, iNOS and COX-2. Over activation and over production of pro-inflammatory factors will further contribute to neuronal death and neurodegenerative diseases. *Kappaphycus alvarezii* is a red algae widely cultivated in Semporna, Sabah, Malaysia, to support the production of kappa-carrageenans for food, cosmetic and pharmaceutical industries. This study aimed to investigate the nitric oxide inhibitory activity of *K. alvarezii*.

Methods: Cytotoxicity effect of *K. alvarezii* extracts (ethyl acetate, ethanol and methanol) in BV2 microglia was examined using MTT assay. Nitric oxide inhibitory activity of all *K. alvarezii* extracts in LPS-stimulated BV2 microglia was evaluated using Griess assays. Inhibition of pro-inflammatory factors (iNOS and COX-2) by the most promising *K. alvarezii* extract on the LPS-stimulated BV2 microglia was assessed using western blotting.

Results: All extracts had maintained cell viability above 80% at the concentration of 2.5 mg/mL. Ethyl acetate extract inhibited 90% nitric oxide production without reducing cell viability at 2.5 mg/mL, thus ethyl acetate extract had been selected for western blot. Ethyl acetate extract had slightly inhibited COX-2 production but it had significantly ($p \leq 0.05$) inhibited iNOS production in dose-dependent manner.

Conclusion: All *K. alvarezii* extracts have demonstrated nitric oxide inhibitory activity with no cytotoxicity effect towards BV2 microglia. Moreover, *K. alvarezii* ethyl acetate extract had contributed to the nitric oxide inhibitory activity by regulating the expression of iNOS.

V204

INFLAMMATORY AND DOPAMINERGIC ABNORMALITIES IN PREFRONTAL CORTEX AT 12-MONTHS FOLLOWING DIFFERENT SEVERITIES OF TRAUMATIC BRAIN INJURY

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Introduction: Traumatic brain injury (TBI) is a major cause of death and disability worldwide. It is now well-recognised that TBI results in acute changes in neuroinflammation and dopaminergic dysfunction, which may act synergistically to increase the risk of later development of neurodegenerative disease. Despite this, however, how these systems are altered chronically following injury is still poorly understood. Additionally, whether such effects differ depending on the severity of the initiating injury remain largely unexplored.

Methods: To investigate this, male Sprague-Dawley rats (420-480g; 10-12 weeks) were either given a sham surgery (n =14) or subjected to Marmarou's impact acceleration model of diffuse TBI of one of three severities: a single mild TBI (mTBI; n = 12); repetitive mild TBI, defined as 3 mild diffuse injuries at 5-day intervals (rmTBI, n =14) or moderate/severe TBI (msTBI, n = 14).

Results: Preliminary results demonstrated no chronic neuroinflammation, as indicated by IBA1 and GFAP staining at 12 months post-TBI. However, mTBI rats showed increased DRD1 expression compared to sham (P=0.0024) and rmTBI groups (P=0.0034), but not to msTBI group (P=0.2236) in Western blot analysis. No differences were found in any other markers of dopaminergic or noradrenergic transmission (TH, DRD4, COMT, DBH, ADRA1a, ADRA2a, ADRB1).

Conclusion: Taken together, we demonstrated long-lasting alterations of DRD1 expression following TBI, which may differ depending on the severity of the initiating injury. This may represent a prolonged recovery process following mTBI, as DRD1 signalling has previously been shown to prevent neuronal death and suppress injury-related neuroinflammation.

0401

STEREOLOGICAL ANALYSIS OF HEART VENTRICLES DURING THE DEVELOPMENT OF OSTEOARTHRITIS IN DUNKIN HARTLEY GUINEA PIGS

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Introduction: Osteoarthritis (OA) was attributed to mobility issues which implicate an increased workload of the heart. This imposed greater stress on the ventricular wall, resulting in a maladaptive reaction known as left ventricular hypertrophy (LVH). Previous studies suggested that OA patients are susceptible to developing cardiovascular diseases, but its association with LVH is not yet established. Therefore, the present study aims to determine changes in nucleus diameter and ventricular cardiomyocytes' density along with the morphology of the heart ventricles during the development of OA in Dunkin Hartley (DH) guinea pigs.

Methods: The histological images of the DH knee joint were taken at 10, 20 and 30 weeks old and were assessed on the degree of articular cartilage degeneration using Osteoarthritis Research Society International (OARSI) scoring. The stereology method was used to determine the nucleus diameter (ND), cardiomyocytes' density (CD), the ventricles wall's thickness (VT) and volume of the ventricular chamber (VV).

Results: The result showed that the severity of OA increased as DH grew old. Across the time points, ND, CD and VV chamber increase at the left and right ventricles, whereas VT increases only in the left ventricular chamber ($p < 0.05$). The left ventricle presented a slightly greater ND, CD and VT and a smaller ventricular chamber than the right ventricles. Findings suggested that DH's heart showed hypertrophy, yet none significantly associated with OA scores ($p > 0.05$).

Conclusion: Since this preliminary study indicates the possibility that LVH is present in OA individuals it is suggested that further investigation should be conducted.

0404

A REVIEW ON NON-VASCULARISED PERIOSTEAL GRAFT TRANSPLANTATION: A PROMISING APPROACH IN BONE HEALING MANAGEMENT

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Introduction: Periosteal graft transplantation is a procedure used for the management of bone defects. The periosteum comprises of two major layers; the outer fibrous and inner cambium layer. Given the fact that the inner cambium layer is immensely rich in osteoprogenitor cells and is highly vascular, vascularised periosteal graft is used for the management of bone defect and fracture. Nevertheless, vascularised periosteal graft transplantation is expensive, time-consuming, and is often associated with post-operative complications. Therefore, this narrative review explored the use of non-vascularised periosteal graft as an alternative method for the management of bone fracture.

Methods: The review was conducted using two search terms “non—vascularised periosteal graft” or “free periosteal graft” and “fracture healing” or “bone gap” using Google scholar and Scopus databases. Relevant articles were identified, reviewed and selected based on several selection criteria: (1) Articles are published in English language from 2010 to 2021 and (2) Articles provides adequate description on the use of non-vascularised periosteal graft.

Results: The review highlighted that the use of non-vascularised periosteal graft improved the healing process of the allograft and preserved its integrity. Besides, it also aids cartilage repair via endochondral mechanisms by promoting endochondral ossification.

Conclusion: The use of non-vascularised periosteal graft transplantation as an alternative technique seems promising for the management of bone defects and repair of cartilage.

V406

ABERRANT VASCULATURE OF HEAD AND NECK IN CAROTID TRIANGLE: CLINICAL IMPLICATIONS

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Introduction: Knowledge about aberrant vasculature of the head and neck region is extremely important for various surgical, anaesthetic, radiological and diagnostic interventions. In general, the venous system has more variations than the arterial system. Most common variations are associated with tributaries of external and internal jugular veins.

Methods: Meticulous dissection was carried out bilaterally in ten (10) well-preserved formalin embalmed cadavers. The pattern of venous drainage and tributaries of external and internal jugular veins along with the branching pattern of the external carotid artery were explored. The level of bifurcation of the common carotid artery was also noted.

Results: Aberrant vasculature was found in three cadavers unilaterally on the right side. In two cadavers, high bifurcation of the common carotid artery was also found. Neck vasculature in the rest of the cadavers was normal.

*Case 1-*Facial and lingual arteries arise from external carotid artery via a common linguofacial trunk just below the level of hyoid bone. Also, common facial vein was draining into the external jugular vein.

*Case 2 and 3-*Facial and lingual arteries arise from external carotid artery via a common linguofacial trunk.

Conclusion: Aberrant branching patterns are imperative for microvascular anastomosis in reconstruction surgeries of the head and neck, carotid endarterectomies, central venous catheterization, facial reconstruction, and radical neck dissection surgeries. These variations should always be kept in mind during any intervention in the region of the head and neck.

0506

PERSUASIVE GAMIFY PROBLEM-BASED LEARNING IN MEDICAL CURRICULUM: A PROMISING AND ENGAGING APPROACH FOR LEARNING CLINICAL APPLIED ANATOMY

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Introduction: Anatomy is a content-driven subject which is taught during the preclinical phase of medical curriculum. In Malaysian medical schools, clinical application of anatomy knowledge during the preclinical years is mainly emphasized during the problem-based learning (PBL). However, previous studies have shown that effectiveness of traditional PBL is inconclusive, and it is dependent on systematic and strategic implementations to ensure active participations from students. Hence, using the Maastricht 7-steps PBL process as foundational framework, this study aimed to develop the persuasive gamify PBL framework in medical curriculum, which is more systematic and engaging compared to the traditional PBL.

Methodology: Two scoping reviews were conducted: 1) to explore the effective learning behaviour of students in PBL, and 2) to discover the persuasive gamify elements that enhanced students' learning. The evidence-based elements from both scoping reviews were mapped according to the Maastricht 7-steps process.

Result: The mapped process generated nine principles with their strategies namely: (1) realistic case scenario; (2) clarify unfamiliar words through interactive questioning; (3) highlight and justify key problem; (4) interactive problem analysis; (5) link the information using schematic mapping; (6) formulate important learning issues; (7) showcase self-study outcome and peer support effort; (8) interactive knowledge sharing; and (9) gamified-based assessment and feedback.

Conclusion: This study proposed an evidence-based persuasive gamify PBL framework that serves as a systematic guideline in creating an engaging PBL instructions. Considerably more work will need to be done to determine the effectiveness of this guideline in enhancing horizontal and vertical integration of anatomy knowledge.

0507

THE DESIGN AND DEVELOPMENT OF WORK-BASED SURFACE ANATOMY TEACHING (WSAT) FRAMEWORK

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Introduction: Surface anatomy are prerequisites for the development of clinical skills competency. Despite the importance of surface anatomy, there has been little emphasis on its content in anatomy curriculum. The lack of surface anatomy competency among medical students have been linked to weak procedural skills and unsafe clinical practice. The substandard surface anatomy education prompted an evidence-based pedagogy. In the integrated medical curriculum, a work-based approach could serve as an effective approach as it could enhance the competency of surface anatomy among students.

Method: Two scoping reviews were performed to explore the effective strategies in surface anatomy teaching (in Scoping review 1); and effective strategies in work-based teaching (in Scoping review 2). A framework was constructed based on the findings from these reviews, whereby the elements yielded from both scoping reviews were used to generate a theoretical pillars of the framework.

Results: Four main themes were generated from these reviews, namely (1) contextualised teaching, (2) embrace clinical experiential learning, (3) learning facilitation and (4) conducive learning atmosphere. The proven teaching strategies were used to develop a functional framework of WSAT, whereby five principles were identified as a basis of the framework, namely, (1) Active engagement, (2) Practice, (3) Reflection, (4) Institutional Support and (5) Learning of Professionalism.

Conclusion: This study proposed an evidence-based framework that provides a practical guideline to conduct work-based surface anatomy teaching. Nevertheless, the framework should be validated by experts and potential users, and its effectiveness on students learning competency should be explored, prior to its implementation.

0508

CLINICAL YEAR STUDENTS' REFLECTION ON ANATOMY LEARNING EXPERIENCE: A KEYSTONE TO DEVELOPING AN INTEGRATED PRECLINICAL ANATOMY TEACHING

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Introduction: Anatomy knowledge is a foundation of medical knowledge that bridges the basic science with clinical subjects. Having adequate anatomy knowledge would enhance the student's performance during clinical years. This study aimed to explore the problems and challenges in anatomy learning faced by clinical years medical students. It also reflected how preclinical anatomy training prepared them for their clinical years.

Method: A qualitative phenomenology study using a focus group discussion method was conducted involving 30 final-year students from four public universities. The response obtained from the focus group discussion sessions were transcribed, converted into electronic formats, and analysed using the ATLAS.ti version 22 software. A thematic analysis identified overarching themes suggesting the key concepts of the problems and challenges experienced by the students when learning anatomy and applying their anatomy knowledge throughout their clinical years.

Results: Of 79 open codes related to the problems and challenges experienced by the participants, five major themes with underlying 17 subthemes emerged, namely: (1) anatomy is a cognitively challenging subject, (2) lack of knowledge relevance, integration, and clinical application, (3) limited teaching approaches and resources, (4) lack of student-centred learning and (5) cultural sensitivity limited the learning opportunity.

Conclusion: These findings are valuable as a cornerstone for identifying the elements of anatomy-related competencies for developing integrated preclinical anatomy teaching.

V509

THRESHOLD CONCEPTS IN CLINICAL ANATOMY EDUCATION

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Introduction: Threshold concepts are areas in education that once mastered, will produce a qualitative leap in student knowledge. This study attempted to identify what topics are considered 'threshold' by medical students in learning anatomy.

Methods: An online questionnaire describing the threshold concept with examples, and how these could challenge one's learning process was shared with first year medical students at the end of their academic year (n=64). The open-ended questions prompted students to identify three threshold areas in their anatomy curriculum, explain why they are so and how students could benefit by mastering those concepts. Students also picked other threshold topics from a pre-identified list and suggested in what ways they could learn them better.

Results: Most students identified topics within the nervous system (25%), head and neck (13%) and musculoskeletal system (13%) as threshold, in their open-ended choices; learning difficulty included numerous structures to remember, spatially orient them to each other and relate them to clinical scenarios. Commonly chosen topics from the pre-identified list were somatic/autonomic nervous system, peritoneum, and inguinal canal. To facilitate learning such difficult topics, students preferred animated 3D models (36%), more practice questions (31%) or physical resources (23%) representing those structures.

Conclusions: There are specific concepts in anatomy that are consistently difficult for students to learn. Based on the findings from this study, the authors suggest that anatomy educators should identify threshold concepts specific to their curriculum and develop pedagogical or innovative techniques to address them in routine teaching.

0523

IMPROVING ANATOMY LEARNING FOR FIRST YEAR DENTISTRY STUDENTS USING ONLINE QUIZZES AND PERSONALISED LEARNING METHODS

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Introduction: The delivery of Anatomy to first year Dentistry students involved didactic lectures followed by practical classes. Despite being the core component for first year Dentistry, a fraction of students struggles with the subject and performs poorly in the assessment. This study aims to improve Anatomy learning via in-class quizzes and other personalised learning methods.

Methods: Topics were divided into Intervention and Control respectively. Intervention topics (n=10) incorporated in-class *Kahoot!* quiz and additional personalised learning activities. Students were instructed to engage in extra self-learning on these topics and present their learning output through their methods of choice; namely, but not limited to essay writing, video presentation, poster, drawing, comic strip and song. The control topics (n=10) included no additional learning activities other than normally prescribed previously. Student perception of the activities were assessed using an end-of-year online questionnaire and analysed using χ^2 test. Students' performance during continuous assessments were analysed using one-way ANOVA.

Results: Most students answered positively for in-class *Kahoot!* quizzes; for increase in topic understanding and class fun. Many responded favourably on the personalised learning assignments given throughout the course. Student ethnicity appeared to influence their response on lecturers, *Kahoot!* and spectrum quiz usefulness ($p < 0.05$, χ^2 test). Performance analysis revealed no difference in student performance in the Intervention topics compared to Control ($p > 0.05$, One-Way ANOVA).

Conclusion: In conclusion, this study revealed that *Kahoot!* increases student engagement whereby additional personalised learning activities were favourable but these did not significantly improve student performance.

0530

IS HUMAN RETINA A POORLY DESIGNED STRUCTURE? ANALYSIS BETWEEN CREATIONIST AND EVOLUTIONIST VIEW

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Introduction: Human retina is an inverted structure causing the light to travel multiple layers to reach the photoreceptors. Evolutionist scientist assumed this a poorly designed structures. It is considered as a scar of past evolution causing the presence of blind spot. In contrast, creationist scientist refuted the idea by proposing necessary visual functions associated with the structure.

Methodology: Selected articles and journals from google seached engine were chosen to analysed both views of creationist and evolutionist. All related English journal/articles were selected within the span of 10 years. Information from unofficial sources were discarded in the study.

Results: Evolutionist views back-wired designed lead to blindspot, detached retina, macular regeneration, angular closure glaucoma, unnecessary extraocular muscles and susceptibility to disease. On other side of coin, creationist view the design is important to avoid degradation of photoreceptors, production of high resolution of image, tolerated blindspot, good visual acuity and a superior space saving solution.

Conclusion: The structure of human eye demonstrated optimal condition for proper functioning of visual images. No single ultimate structures are free from diseases or deficiencies. The inverted retina structures are not uniquely to human alone. It fit the purpose of providing the necessary visual functions.

V532

THE NEED FOR ANALYSIS OF ANATOMY CONTENT FOR THE TRAINING OF TRADITIONAL MALAY PRACTITIONERS

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Introduction: Anatomy knowledge enhances health practitioners' skills in treating patients and communicating clinical findings with other health personnel. Due to changing community preference for traditional and complementary medicine, the demand for traditional Malay practitioners' services is also increasing. However, owing to the lack of formal anatomy education and training among the traditional Malay Medicine practitioners, a standard curriculum is essential to provide at least the basic anatomy content in creating unified and standard practices among the practitioners in Malaysia.

Method: This communication was conducted based on eleven selected full articles from the Jurnal Filologi Melayu related to anatomical terminologies found in the traditional Malay Medicine literature.

Results: The available traditional anatomical knowledge and terminologies used among the traditional Malay medicine practitioners for anatomical structure identification are not well discussed academically to help educators relate the traditional Malay practitioners' level of understanding with the modern gross anatomy content.

Conclusion: Hence, a collaboration between the academic training providers, experts in the traditional Medicine field, and the traditional Malay practitioners is possibly a kickstart in exploring curriculum needs and the subsequent education development. This article unearths available traditional Malay knowledge and resources related to anatomical structures, the possible benefits, and challenges in preparing anatomical content for training the traditional Malay practitioners. It highlights the need to design modules for basic anatomical content for training and education in the Malaysian context.

0533

IMPACT OF COVID-19 TOWARDS THE OUTCOME OF ANATOMY PRACTICAL ASSESSMENT IN THE UNIVERSITI MALAYA MEDICAL PROGRAM (UMMP)

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Introduction: Anatomy, the cornerstone of medical education, has undergone a great paradigm shift even before the pandemic. As the Covid-19 outbreak emerged, our institution, like many others worldwide, was forced to go into a total lockdown. Anatomists at Universiti Malaya (UM) were suddenly expected to teach gross anatomy without using cadavers and 3D specimens, offering hands-on experience. This study was designed to analyse why the most recent post-pandemic face-to-face (F2F) exam yielded more medical students failing the anatomy practical component despite passing all other components. We also perused the evolvement of anatomy learning in the era surrounding COVID-19 by analysing the results of practical assessments obtained by the preclinical undergraduates during this period.

Methods: Results from the Anatomy Practical Summative examinations were sampled from sessions 2016/2017 to 2021/2022 (6 years). The percentage of students who passed and failed was gathered and analysed. Question designs were also reviewed.

Results: Anatomy practical exams conveyed online during the pandemic showed a low failure rate percentage and the number of students scoring more than 80% was double the pre-pandemic value. However, in the recent F2F examination, the percentage of students who failed the anatomy practical exam was slightly startling and this called for a session of effective brainstorming.

Conclusion: Apart from the changes in the format of questions designed across the pandemic, other subtle factors were also noted and discussed.

V601

FORENSIC CRANIOFACIAL SUPERIMPOSITION: COMPARISON OF REAL-WORLD AND DIGITAL APPROACHES

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Introduction: Craniofacial superimposition is a comparative method used by forensic anthropologists when matching a skull to a suspected victim's face photograph. Conventionally, only physical craniofacial reconstruction was available. Recently, virtual craniofacial superimposition has been made available to researchers with the Skeleton-ID software.

Methods: This research compares physical and virtual craniofacial superimposition analysis from the aspect of cost, setup, ease of use from a teaching, research and forensic case perspective. The physical craniofacial superimposition method is conducted utilizing a Craniofacial Superimposition Video Device (CASVID) present in Universiti Sains Malaysia while the virtual method is conducted with the Skeleton-ID software on a computer with dedicated graphics and a 27" monitor display.

Results: Both systems have their benefits and drawbacks. Institutions with a physical craniofacial superimposition arrangement should use it, given the number of comparisons, expense, and individual privacy. Physical craniofacial superimposition does not require licence fees and privacy is upheld as data is stored locally. Physical skull examinations are easier than virtual ones, especially for identifying minute facial traits. Virtual craniofacial superimposition preserves a sterile environment and can be conducted anywhere on a pc with a dedicated graphics card and with internet connection. The software also offers wipe mode picture processing, automatic landmark placement, and 2D and 3D craniofacial superimposition. Both approaches have training and certification; the setup decision is personal.

Conclusion: Both physical and virtual craniofacial superimposition have different strengths and weaknesses and the best method for each user is dependent on their individual needs.

V602

SHAPE VARIATION OF MANDIBULAR ANATOMY IN THE MALAYSIAN POPULATION BY CT SCAN: A GEOMETRIC MORPHOMETRIC METHOD FOR IDENTIFICATION OF ANCESTRY

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Introduction: Ancestry is considered the most difficult aspect of a biological profile to determine. With the imminent mixed social constructs, forensic anthropologists have difficulty determining ancestry or ethnicity. Anthropologists have classified human into three categories i.e. Caucasoid, Negroid and Mongoloid. Mandible is one of the unique bones that can be differentiated into several racial groups due to its variety in functional activity. The aim of this study was to determine shape variation in the mandible in three main ancestries in Malaysia.

Methods: About 24 landmarks were applied to CT scan data using Stratovan Checkpoint software. Various analyses were done using geometric morphometric methods in MorphoJ software. The sample comprised 447 mandibles, of which 150 were Malays, 137 Chinese, and 160 Indians were collected for identification purposes.

Results: From Procrustes ANOVA, the mandible's size and shape were significantly different among ancestries ($p < 0.01$). Canonical variate analysis (CVA) graph revealed that the pattern of distribution for the Malays was located between the Chinese and Indians. The Indians and Chinese differed significantly from the Malays, and two canonical variates were produced from the canonical variate analysis. The Mahalanobis and Procrustes distances demonstrated the highest values in the Chinese and Indians. Besides, the ANOVA and post hoc test showed that the Malays and Chinese were significantly different from the Indians. Discriminant function analysis of the mandible exhibited 61% classification accuracy after cross-validation among ancestries.

Conclusion: In conclusion, the mandible can be used to differentiate between the Mongoloid (Malay and Chinese) and Caucasoid (Indian) ancestries in the Malaysian population using geometric morphometric analysis.

0702

PALMARIS LONGUS MUSCLE AGENESIS IN BANJARESE PEOPLE IN SOUTH KALIMANTAN INDONESIA

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Introduction: Palmaris Longus Muscle (PLM) agenesis is a human anatomy anomaly which characterised by the absence of PLM muscle. Despite its controversy, some study report that PLM agenesis was related to low sustainability in sport handgrip. This anomaly is usually diagnosed by using a standard test such as the Schaeffer test, Mishra test and other minor test. This study aims to describe the prevalence of PLM agenesis in Banjarese, a native tribe in South Kalimantan.

Method: This study used a descriptive observational study design with a survey approach. Purposive and cluster sampling method were used to recruit 160 respondents from 10 villages in the city of Banjarmasin. PLM diagnosis was performed by using Schaeffer Test and further confirmed by Mishra and other tests. The subject was defined as having PLM agenesis if all these confirmatory tests did not reveal the PLM tendon.

Results: Out of 160 respondents, there were 18 respondents (11.25%) who had PLM agenesis. The prevalence of PLM agenesis was higher in women (16.25%) than men (6.25%), and among those who aged less than 41 years old (12.38%). In addition, PLM agenesis was also more commonly found in respondents who had the right dominant hand (83.33%) as compared to those who had the left dominant hand (16.67%).

Conclusion: The prevalence of PLM agenesis in Banjarese, a native tribe in South Kalimantan was 11.25 %, which majority of them was right dominant hand. This give clinical significance that among population, tenth of Banjarese tribe may develop weak sustainability in handgrip activity.

V703

HAND ANTHROPOMETRY: BASELINE DATA OF THE MAJOR ETHNIC GROUPS IN SABAH

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Introduction: Anthropometry is a scientific specialization that applies measurement to appraise human size, shape, proportion, composition, development, and gross function. In considering the multi-ethnic population in Sabah, there is still a paucity of data among Kadazan Dusun, Bajau, Malay, and Chinese ethnicities. The study was designed to create baseline data for normative values of hand dimensions of major ethnic groups in Sabah.

Methods: This cross-sectional study was conducted from February 2021 to January 2022. The researchers randomly stratified 368 students into four ethnicities and further stratified into males and females. Length, breadth, and span of hand, length and second inter-crease length of middle finger were measured using a digital calliper.

Results: In the obtained baseline data, the right handbreadth was broader than the left hand ($p < 0.01$). Males had higher measurements than females ($p < 0.001$); however, there was no significant difference among the four ethnicities.

Conclusion: Further study at the community level is recommended for different age groups and ethnicities by addressing hand activity, hormones, and brain asymmetry to obtain holistic data on the Sabahan population.

V704

GEOMETRIC MORPHOMETRIC STUDY OF THE FIRST LUMBAR VERTEBRA FOR SEX ASSESSMENT IN THE MALAYSIAN POPULATION

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Introduction: The geometric morphometric is a recent advanced technique used on human anatomic structures to represent statistical actual shapes or forms for identification purposes in the forensic anthropology field. Traditionally, the first lumbar vertebra had been reported to be sexually dimorphic among the other lumbar vertebrae. The aim of this research was to analyze the L1 vertebra for classification of sex in the Malaysian population by geometric morphometric approach.

Methods: A total of 226 samples of adults, aged between 20 and 65 years old, were taken from 3D CT scan images. By the Stratovan Checkpoint software, 27 landmarks were applied and analyzed using the MorphoJ software.

Results: There was significant difference between sexes in centroid size of the L1 vertebra by independent t-test ($p < 0.05$). By Procrustes ANOVA, it showed significant difference in both shape and centroid size between sexes ($p < 0.001$). The discriminant function analysis (DFA) predicted 77.35% accuracy in different sexes in cross-validated grouped cases. The visualization of size and shape variations between males and females was demonstrated in the vertebral body of the L1 vertebra.

Conclusion: The L1 vertebra body is sexually dimorphic by 3D geometric morphometric among the Malaysians. The visualization model of L1 vertebra in this study provided an important reference, where identification of an unknown person is required in a forensic case scenario.

V802

BEST PRACTICE FOR STEREOLOGICAL QUANTIFYING THE MICROSCOPIC STRUCTURE OF MOUSE LIVER

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Introduction: The method of stereology involves collecting samples and counting material using specific protocols in order to estimate quantitative parameters, such as numbers, volumes, surfaces or lengths. This method applies to a variety of structural levels, including the entire organ, a cell, and a molecule. In addition, it provides efficient and unbiased methods to quantify functionally relevant aspects of three-dimensional morphology. Here, we offer stereological best practices applied to acute liver injury induced by concanavalin(Con) A in mice.

Methods: Mice with functional TLR4 (C3H/HeN) and TLR4-defective (C3H/HeJ) were administered ConA. The whole liver was sliced into 2 mm thick slabs at a uniform random position. Each liver slab was divided into a set of equal pieces to width. The isotropic uniform random sampling of the liver tissue block at a random position. All of the interfaces of the sampled blocks were according to the Cavalieri technique. The images were digitally saved for each slide representing each liver of each animal for stereological analysis. The cross-grid point hits the liver tissues that consist of necrotic tissue area and normal liver architecture.

Results: C3H/HeN mice developed massive necro-apoptotic hepatocyte changes. C3H/HeJ mice exhibited reduced necro-apoptotic hepatic changes.

Conclusion: The stereological analysis employed in this study to estimate necrosis volume density representation of the whole liver mass by applying point-counting is very fast. This estimation is recommended for liver tissue to get an acceptable coefficient of error of about 10%.

0805

THE IMPACT OF ROBOTIC REHABILITATION ON MID-THIGH AND MID-CALF CIRCUMFERENCES AND FUNCTIONAL OUTCOMES OF STROKE PATIENTS

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Introduction: Robotic rehabilitation has created a major turning point in stroke rehabilitation to improve stroke survivors' functional status and quality of life. Therefore, the aim of this study was to assess the impact of robotic rehabilitation on the mid-thigh and mid-calf circumferences and functional outcomes of stroke patients.

Methods: In this prospective cohort study, stroke patients underwent conventional rehabilitation (CR) (n=10) and robotic rehabilitation (RR) (n=10) groups using purposive sampling method. Patients in CR group received a five-day-a-week home-based rehabilitation program and three sessions of rehabilitation at the tertiary centre for four weeks. Patients in the RR group received a five-day-a-week CR program with additional robotic therapy using the HAL® Cyberdyne for lower-limb, for four weeks. Outcome measures including mid-thigh and mid-calf circumferences, Functional Ambulation Categories (FAC), 6-Minute Walk Distance (6MWD) and World Health Organization Quality of Life Brief Version (WHOQOL-BREF) scores.

Results: A total of 20 participants had completed the study. Mid-thigh and mid calf circumferences of the hemiparetic lower limbs portray an increment of the circumferences after robotic rehabilitation. Subsequently, the hemiparetic lower limbs of RR participants showed more improvements in the FAC and 6MWD after four weeks of rehabilitation.

Conclusion: Robotic rehabilitation had shown significant effects on the mid-thigh and mid-calf circumferences and functional outcomes of stroke patients. Larger sample size and a more specific study targeting muscle mass should be considered in the future to strengthen the evidence.

Trial Registration: Ethical approval from Universiti Sains Malaysia Human Ethics Research Committee (JEPeM): USM/JEPeM/21090603

P102

PHYSICOCHEMICAL PROPERTIES OF DEHYDRATED AND RAW STINGLESS BEE HONEY

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Introduction: Stingless bee honey (SLBH), which has health benefits, is susceptible to alcoholic fermentation by microorganisms due to high moisture content. Dehydration of SLBH upon collection is needed to reduce the moisture to ensure good quality of SLBH. However, the dehydration process can increase hydroxymethylfurfural (HMF) in honey which is an indicator of overheating, ageing, and a potential carcinogenic and genotoxic compound. This study investigates the physicochemical properties of SLBH before and after dehydration.

Methods: SLBH of *Geniotrigona thoracica spp.* was harvested in April 2022 from a farm in Gombak, Selangor. After harvesting, part of raw SLBH was dehydrated using the Malaysian Agricultural Research and Development Institute (MARDI) dehydrator at 32 - 39°C for 20 hours. The physicochemical properties were evaluated for both dehydrated and raw SLBH.

Results: Following dehydration, the moisture content was reduced from 31 to 14.3%. The parameters of raw SLBH were HMF = 0.3 mg/kg, pH of 3.3, free acidity = 274.8 mEq/kg, trehalulose = 52 g/100g, glucose = 11 g/100g, and fructose = 8.5 g/100g. The parameters of dehydrated SLBH were HMF = <0.1 mg/kg, pH of 3.5, free acidity = 138 mEq/kg, trehalulose 48.5 g/100g, glucose = 7.3 g/100g and fructose = 8.1 g/100g. In both samples, ash content was 0.2 g/100g, while diastase activity, maltose and sucrose were not detected.

Conclusion: Dehydration of SLBH can reduce the moisture content and improve its pH without overheating and altering the mineral, as evidenced by no increase in HMF and no reduction in ash content, respectively.

P104

BIOACTIVE COMPOUNDS OF DEHYDRATED AND RAW STINGLESS BEE HONEY

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Introduction: Stingless bee honey (SLBH) naturally contains high moisture level making it more prone to rapid alcoholic fermentation. Therefore, dehydration process of SLBH after harvesting is needed to reduce the moisture level to prevent honey spoilage. This study aims to identify the differences of the bioactive compounds between the dehydrated and raw SLBH from *Geniotrigona thoracica* spp.

Methods: The raw SLBH from *Geniotrigona thoracica* spp. was harvested in April 2022 from a farm in Gombak, Selangor. After harvesting, the raw SLBH was immediately dehydrated using the Malaysian Agricultural Research and Development Institute (MARDI) dehydrator machine at 32 - 39°C for 20 hours. Then, the dehydrated and raw SLBH were analysed using Liquid chromatography-mass spectrometry (LC- MS) for the identification of bioactive compounds.

Results: Overall, 33 bioactive compounds were detected in dehydrated SLBH comprised of 10 sugars, 2 amino acids, 6 polyphenols, 5 iridoid glycosides, 1 phenylpropanoids, and 9 other organic compounds. Meanwhile, 25 bioactive compounds were detected in raw SLBH comprised of 5 sugars, 2 amino acids, 7 polyphenols, 3 iridoid glycosides, 2 phenylpropanoids, and 6 other organic compounds. Polyphenols detected in both samples were calycanthoside, dihydro-3- coumaric acid, epigallocatechin(4 β ,8)-gallocatechin, 6"-O-p-hydroxybenzoyliridin, and glehlinoside B. On the other hand, luteolin-7-O- α -D-glucoside was detected in dehydrated SLBH, while sinapic acid and 5'-methoxy-bilobetin were detected in raw SLBH.

Conclusion: Dehydration process caused variation in bioactive compounds of SLBH. However, the polyphenols compounds in the dehydrated SLBH play an important role in its antioxidant activities.

P105

PROTECTIVE EFFECTS OF TUALANG HONEY SUPPLEMENTATION ON THE PREFRONTAL CORTEX FOLLOWING CHRONIC STRESS EXPOSURE IN RAT MODEL

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Introduction: Chronic stress exposure produces oxidative stress damage in the brain which contributes to the emergence of many stress-related illnesses. Tualang Honey (TH) is a Malaysian wild polyfloral honey with higher phenolic and flavonoid contents. It has stronger antioxidant and anti-inflammatory properties potentially capable of protecting the brain against stress-induced oxidative damage. This study aimed to determine the protective effects of TH on astrocytes and microglial cells in the medial prefrontal cortex (mPFC) of rat models following chronic stress exposure.

Methods: Twenty-four male Sprague Dawley rats were divided into (i) control, (ii) stress-exposed, (iii) Tualang Honey treated group (1.0 g/kg body weight twice daily), and (iv) stress-exposed treated with Tualang Honey (1.0 g/kg body weight twice daily). Group (ii) and group (iv) underwent a combination of restraint stress test (RST) and forced swimming test (FST) for 21 days. The parameters were measured using Fiji J image and IC Measure software.

Results: This study found that TH supplementation significantly increases the number of GFAP positives astrocytes ($p < 0.001$) in the stress-exposed group. While, the number of Iba-1 positive microglial cells in the stress-exposed group treated with TH supplementation showed a significant reduction ($p < 0.001$). However, the number of primary processes and the maximum branch length of both glial cells ($p > 0.05$) following chronic stress exposure were unaffected by TH supplementation.

Conclusion: These findings suggest that TH supplementation has demonstrated its protective effects specifically in astrocytes and microglial cell counts possibly via its antioxidant and anti-inflammatory properties following exposure to chronic stress.

Trial Registration: Ethical approval from Animal Ethics Committee of Health Campus, USM (AECUSM) [USM/IACUC/2020/ (123) (1066)].

P107

ISOLATION OF ADIPOSE DERIVED STEM CELLS FROM ADIPOSE TISSUE OF RAT: A PILOT STUDY

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Introduction: Adipose derived stem cells (ADSCs) have been widely used in stem cell based therapies in regenerative medicine. Harvesting of ADSCs from different species of animal adipose tissues yielded variable amount of multipotent stem cells. The aim of this pilot study was to determine the number of yielded cells according to the sites of adipose tissue harvested from rat.

Methods: One six-month old, male Sprague Dawley rat was euthanised. Adipose tissues were harvested from six different sites: inguinal fat, subcutaneous fat, epididymal fat, mesenteric fat, perirenal fat, and interscapular fat. The harvested fatty tissues were weighed, finely minced and washed with sterile phosphate-buffered saline solution. Further steps in stem cell culture of ADSCs were carried out according to the standard laboratory protocol. The morphology and number of ADSCs were observed under phase contrast inverted microscope every second day until 14 days of culture.

Results: From Day 1 until Day 14 of cell culture, the isolated ADSCs showed gradual changes in morphology, from cells showing heterogeneous morphology with, star-, and elongated-shaped cells into cells with multiple cytoplasmic processes. There were also cells with large nuclei and fibroblast-like appearance. It has been found that the cells isolated from inguinal, subcutaneous and mesenteric fat showed minimal growth compared with that from perirenal, epididymal and interscapular fat.

Conclusion: It is concluded that perirenal, epididymal and interscapular fats represent the highest yield sites for ADSCs harvesting. Further steps of stem cells characterization is necessary to determine the multipotency of the cells.

P108

ELUCIDATING VASCULAR PROTECTIVE EFFECT OF THYMOQUINONE IN HOMOCYSTEINE- INDUCED ENDOTHELIAL DYSFUNCTION: IN VITRO AND EX VIVO MODEL

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Introduction: Hyperhomocysteinemia has been linked to an increased risk of cardiovascular diseases. High levels of homocysteine (Hcy) promote endoplasmic reticulum (ER) stress that can increase reactive oxygen species (ROS), leading to endothelial dysfunction. Thymoquinone (TQ), the major active ingredient in *Nigella sativa* seeds' volatile oil possesses antioxidant and anti-inflammation effect. However, there is no study done to evaluate the effect of TQ against Hcy- induced endothelial dysfunction. Thus, the objective of this study was to investigate the effects and possible mechanism of TQ in reversing Hcy-induced endothelium dysfunction.

Methods: In an *ex vivo* model, the aorta of 8-week-old male Sprague-Dawley (SD) rats was isolated and incubated with Hcy (500 μ M), TQ (10 μ M), TUDCA (10 μ M), and apocynin (100 μ M) in myograph to study the vascular function. For *in vitro*, human umbilical vein endothelial cells (HUVECs) were incubated with Hcy (4mM), TQ (40 μ M), TUDCA (100 μ M) and apocynin (100 μ M) to evaluate the cell viability by using phase contrast microscope and dye exclusion assay.

Results: Our results revealed that Hcy impaired endothelium dependant relaxation in isolated aorta and induced apoptosis in HUVECs. These effects were reversed by TQ, TUDCA and apocynin, suggesting that the effect of TQ may involve inhibition of ER-stress-mediated oxidative stress pathway induced by Hcy.

Conclusion: Taken together, the results suggested that TQ preserved endothelial function in rat aorta and reduced apoptosis of HUVECs induced by Hcy through the inhibition of ER stress-mediated ROS.

P111

EFFECT OF PALM TOCOTRIENOL ON PROLIFERATION, DIFFERENTIATION AND MINERALISATION OF MC3T3-E1 CELLS TREATED WITH DEXAMETHASONE

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Introduction: Prolonged usage of glucocorticoid causes osteoporosis due to disturbance in bone remodelling process. Primarily it impairs the proliferation and differentiation of osteoblast cells. Vitamin E is a fat-soluble vitamin which consists of tocopherols and tocotrienols, with antioxidant properties. Animal studies had proven the antiosteoporotic effects of palm tocotrienol in various osteoporosis models. The aim of this study was to determine the effect of palm tocotrienol in the proliferation, differentiation and mineralisation of MC3T3-E1 cells after treated with chronic dexamethasone.

Methods: MC3T3-E1 cells were cultured in differentiation media and treated with 150 μ M dexamethasone mixed with 0.25, 0.5 and 1 μ g/mL of palm tocotrienol until day 6, 12, 18 and 24. Cells were harvested and analysed for protein LRP6, Wnt3a, β -Catenin, RUNX2, Collagen and Osteocalcin expression in Wnt/ β -Catenin pathway. Cells also stained with Alizarin Red S for calcium nodule and quantified using microplate reader.

Results: 1 μ g/mL of palm tocotrienol significantly increased the differentiation and calcium deposition in cells treated with 150 μ M dexamethasone until day 12 and 18. However, palm tocotrienol did not show significant effect on the cells proliferation.

Conclusion: These results supported the findings of the previous animal study and as a reference could support previous studies that palm tocotrienol has the potential to protect bone against glucocorticoid induced osteoporosis.

P112

ANTAGONISM BETWEEN TOCOTRIENOL AND BCR-ABL INHIBITORS IN CHRONIC MYELOID LEUKEMIA CELLS TREATMENT

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Introduction: Chronic myeloid leukaemia (CML) is a haematological stem cell cancer that expresses oncogenic Bcr-Abl protein. Imatinib, a Bcr-Abl inhibitor, is the first-line treatment for CML. Several next-generation Bcr-Abl allosteric inhibitors including trifluoromethoxy-phenylaminopyrimidinyl benzamide (GNF-5) are developed and currently under preclinical evaluation. Tocotrienol, a vitamin E subtype, is commonly found in vegetable oils. It has been reported potent anticancer properties against several cancers, however, very limited findings are being reported on CML. In this study, we aimed to determine the anti-leukaemic effects of tocotrienol from annatto bean (AnTT) on human CML K562 cells, with or without the combination of imatinib or GNF-5.

Methods: The viabilities of K562 cells with 24h single treatment of Imatinib (0-100 μ M) or GNF-5 (0-100 μ M) were determined by MTT assay. Subsequently, K562 cells were treated with a range of AnTT concentration (0-50 μ g/mL) with or without the imatinib or GNF-5 at their respective 25% and 50% of half-maximal inhibitory concentration (IC_{50}) values. Their interaction upon combination was determined by using an isobologram.

Results: Imatinib and GNF-5 are cytotoxic to K562 cells with IC_{50} values of 40 μ M and 50 μ M, respectively. Single treatment of AnTT reduced the viability of K562 cells with IC_{50} of 34 μ g/mL but only demonstrated similar or slightly lower IC_{50} values upon combination. Isobologram analysis revealed the antagonistic interactions between AnTT with imatinib and GNF-5.

Conclusion: Antagonistic effects were reported upon the combinational treatment of tocotrienol and Bcr-Abl inhibitors on K562 cells. A further investigation is needed to confirm this interaction.

P203

THE ROLE OF CAFFEIC ACID IN REDUCING THE EFFECTS OF METABOLIC SYNDROME ON WISTAR RATS' BRAINS

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Introduction: Metabolic syndrome (MetS) can cause brain inflammation, insulin resistance and reduces cerebral blood flow. Since MetS is a food-related condition, current therapy focuses on natural products to minimise its effects, including caffeic acid (CA), one of the most abundant phenolic substances in the human diet. We hypothesized that CA could mitigate the ameliorating effects of MetS on the rat brain. Our objectives were to investigate the effect of CA on the MetS parameters, brain cytokines and neurotrophic factor.

Methods: 24 male Wistar rats were divided into 3 groups: Control (C), MetS induced with high carbohydrate and high fructose (HCHF) diet (MS), and HCHF group supplemented with CA, observed over 16 weeks. The abdominal circumference, weight, fasting blood glucose (FBS), lipid profile and blood pressure were collected. Upon sacrifice, the brains were collected and further tests were carried out.

Results: HCHF significantly reduces body weight ($p < 0.05$) while CA returns the body weight at par with control. CA also significantly reduced ($p < 0.05$) systolic BP and FBS compared to MS. Interleukin-6 reduced significantly ($p < 0.05$) in CA compared to MS groups, while BDNF was significantly increased ($p > 0.05$) in CA group. Results showed that while the HCHF diet successfully induced MetS condition, CA was able to mitigate some of these changes. CA also reduces brain cytokines while increasing neurotrophic factor.

Conclusion: We conclude that due to its antioxidative properties, CA has the potential to be used as a fortified supplement to help minimise the detrimental effects of MetS.

P402

BENEFICIAL EFFECT OF PERINATAL *RESVERATROL* ON BISPHENOL A-INDUCED CARDIOVASCULAR CHANGES IN THE ADULT OFFSPRING: A HISTOPATHOLOGICAL STUDY

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Introduction: Perinatal Bisphenol A (BPA) exposure induces cardiovascular diseases in later stages of life. We sought to explore the beneficial effects of perinatal *resveratrol* (Rsv) exposure on BPA-induced cardiovascular changes and hepatic steatosis in offspring.

Methods: The pregnant apolipoprotein E-deficient mice were exposed to only drinking water or BPA in the drinking water (1 µg/ml) or to both BPA (1 µg/ml) and Rsv (oral; 20 mg kg⁻¹ day⁻¹) throughout the gestation and lactation period. After euthanasia with an overdose of ketamine and xylazine, organs including, heart, liver, left kidney, and brachiocephalic artery were collected from 20-week-old offspring mice (n=30 male & n=30 female) for H&E, Masson's trichrome, and Verhoeff-van Gieson staining. One-way ANOVA followed by Tukey's multiple comparison test was used.

Results: In female and male offspring mice, Rsv treatment decreased BPA-induced increased tunica intima to tunica media ratio from 1.3 to 0.5 and 0.72 to 0.29, respectively (p<0.05) and reduced the number of elastic lamina breaks (p<0.05) in the brachiocephalic artery. Rsv inhibited the BPA-induced atherosclerosis lesion progression in initial 2mm length of the brachiocephalic artery (7 random view fields). Rsv treatment decreased the BPA-induced increased left ventricular thickness in female and male offspring by 135µm and 131µm, respectively. Rsv reduced BPA-induced hepatic steatosis in female and male offspring mice (p<0.05). Rsv treatment did not reduce the BPA-induced cytoplasmic vacuolation in the tubules of renal cortex (p>0.05).

Conclusion: Based on study results, Rsv could be a potential protective candidate against perinatal BPA-induced cardiovascular changes and hepatic steatosis.

P403

THE ROLE OF CARBONIC ANHYDRASE IX IN THE OUTCOME OF CLEAR-CELL RENAL CELL CARCINOMA: A RETROSPECTIVE STUDY

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Introduction: Renal Cell Carcinoma (RCC) is known for poor prognosis. A biomarker would be helpful to determine treatment response and disease outcome. Hence, this study aimed to evaluate the association of CAIX expression with demography, clinico-pathological variables, and survival outcomes in RCC patients.

Methods: Archived RCC samples from UMMC (2012-2017) were examined for immunohistochemical tissue expression of CAIX proteins. Samples were selected based on a predetermined inclusion and exclusion criteria. Samples (n=39) were sectioned, stained and observed using an image analysis software to calculate staining intensity. The Kaplan-Meier test was used to generate survival curves whereas the survival difference was evaluated using a log-rank test. Protein significance was analysed using Cox proportional hazard regression.

Results: Sections that qualified analysis (32/39) exhibited localised tumour, with the remainder showing advanced metastatic spread. Univariate analysis revealed that the association of CAIX protein with age, sex, ethnicity, tumour stage, tumour grade, lymph node involvement and metastasis did not reach statistical significance. Low CAIX expression predicted good survival at the end of 5 years ($p < 0.05$). But the Cox proportional hazards regression indicated a minimal association between the biomarker and the three variables investigated ($HR < 1$).

Conclusion: This study revealed that a low tissue CAIX expression is associated with an early, localized tumour and good disease prognosis. However, the association with survival outcomes were weak and carried marginal clinical significance. These inconclusive findings therefore require a follow up by an extensive, multicentre study to examine the role of CAIX as a biomarker for RCC.

P405

FUNCTIONAL STATUS IMPROVEMENT FOLLOWING ROBOTIC REHABILITATION IN STROKE PATIENTS

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Introduction: Stroke is one of the contributing factors to disability worldwide. Salvaging the affected muscles is crucial in restoring functional status. Improvements in motor function help patients to achieve physical, psychological, social, and financial independence. Hence, this study aimed to assess the functional outcomes of stroke patients following robotic rehabilitation.

Methods: Prospective cohort study was carried out on stroke patients who underwent conventional rehabilitation (CR) (n=10) and robotic rehabilitation (RR) (n=10). Functional Ambulation Categories (FAC) and 6 Minute Walk Distance (6MWD) were measured at a specific time interval from the beginning of the study until the completion of four weeks of designated therapy for both groups.

Results: Data from 20 participants were analysed. Participants who underwent robotic rehabilitation illustrated significant between group effect compared to CR in the FAC and 6MWD results after four weeks of therapy.

Conclusion: Incorporating robotic therapy in stroke rehabilitation helps to overcome the weakness in trunk stability and aid in good lower limb coordination. Hence, faster improvement in FAC and 6MWD was observed following robotic rehabilitation.

Trial Registration: Ethical approval from Universiti Sains Malaysia Human Ethics Research Committee (JEPeM): USM/JEPeM/21090603

P408

AN UNUSUAL CASE OF AN EXCEPTIONALLY LARGE ANTERIOR JUGULAR VEIN IN A DISSECTED CADAVER – A CASE REPORT

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Introduction: The anterior jugular vein (AJV) forms part of the superficial venous drainage of the neck. The AJVs are commonly found as paired structures in the anterior midline region which are prone to anatomical variation. AJV inconsistencies contribute to the high percentage of peri-operative bleeding in anterior neck surgery.

Method: Here, we report an unusual case involving the right AJV, which was observed while performing a cadaveric neck dissection in a 60-year-old male subject.

Observation: In this case, we observed an exceptionally large AJV on the right side of the neck, measuring 16 mm in diameter. The size is three times larger than the left AJV, which is regular in size (5 mm in diameter). Both lie on the anterior aspect of the infrahyoid muscles and drain into the subclavian veins on each side, respectively. The jugular venous arch was absent; thus, there was no communication between the right and left anterior jugular veins.

Discussion: Postulated causes for this abnormality include congenital vascular anomaly or possibilities of increased venous pressure due to backward heart failure. Since AJV is a superficial vein, acknowledging the presence of abnormally large AJV is essential in anterior neck surgery.

Conclusion: This finding may provide a better insight for attending surgeons to be aware of aberrant AJV to prevent potential bleeding during surgical procedures, including thyroidectomy, tracheostomy, and emergency cricothyroidotomy.

P502

PRECLINICAL DENTAL UNDERGRADUATES' EXPERIENCE WITH CADAVERIC DISSECTION

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Introduction: Cadaver dissection is important in human anatomy teaching and the students will encounter, most likely for the first time, a dead human body. This study aims to investigate the experience of preclinical dental undergraduates during cadaveric dissection.

Methods: Two hundred and forty preclinical students of the Faculty of Dental Sciences, University of Peradeniya, Sri Lanka were used. A structured questionnaire containing 28 items was distributed after taking the informed consent. Ethical approval was obtained from the Ethics Review Committee of the Faculty of Dental Sciences.

Results: There were 174 respondents (52 males and 122 females). Although a majority of students were excited about visiting the dissecting room for the first time they did not upset or emotionally shocked seriously. Females felt emotional shock more frequently than males ($P < 0.01$). Many students had prepared mentally for the dissection and did not complain of excessive stress. Muslim students complained of more excessive stress than those of other ethnic groups ($P < 0.01$). Furthermore, 47.7% of the students complained of no symptoms during the dissection course while others complained of symptoms such as sweating, dizziness, nausea, etc. Relaxing, and focusing on the task are the most common coping mechanisms used by the students to counter the symptoms.

Conclusion: This study revealed that although cadaver dissection is an exciting and stressful experience majority of students felt ready to participate in the dissections and considered dissection is the best method of learning human anatomy. Educators should assist students in overcoming their initial distress and maintaining respectful attitudes towards dissection course.

P503

PRECLINICAL MEDICAL STUDENTS' PERCEPTIONS OF ANATOMY EDUCATION ENVIRONMENT IN UNIVERSITI SAINS MALAYSIA BEFORE AND DURING THE COVID-19 PANDEMIC

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Introduction: The COVID-19 pandemic has caused closures of campuses resulting in an abrupt shift from face-to-face to distance and online learning. Consequently, students were unable to access various conventional and laboratory learning modalities. Therefore, this study was conducted to measure Universiti Sains Malaysia pre-clinical medical students' perceptions of the anatomy education environment with regard to five domains, namely knowledge relevance, teachers, subject mastery, and learning resources.

Methods: A cross-sectional study was performed using a validated and reliable 26-item, Anatomy Education Environment Measurement Inventory (AEEMI-26). Scores comparison from 156 COVID-19 and 136 pre-COVID-19 cohort students were analysed descriptively and using the Mann-Whitney U test and independent t-test.

Results: Domains of anatomy education environment on knowledge relevance and perceptions of teachers were perceived as positive areas, but domains on subject mastery and learning resources were perceived as areas of improvement in both cohorts. The COVID-19 cohort had significantly higher scores for anatomy education environment domains of knowledge relevance, perceptions of anatomy teachers, and learning resources, but not for subject mastery.

Conclusion: The results suggest the importance of incorporating effective online anatomy learning elements and improving the positive areas of the anatomy education environment particularly by, increasing clinical application content and teacher training. In addition, it is crucial to improve the weaker areas of the anatomy education environment notably by adopting appropriate learning modalities via various approaches and establishing effective communication between lecturers and students.

P504

PREFERENCE OF STUDENTS FROM QUEST INTERNATIONAL UNIVERSITY REGARDING ONLINE TEACHING AND ITS ASSOCIATION WITH SOCIO-DEMOGRAPHIC FACTORS

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Introduction: There was a significant shift toward online teaching during the COVID -19 lockdown, and students' preference on this new teaching approach over the traditional has yet to be determined. This research aimed to estimate the preference of students from Quest International University (QIU) towards online teaching and to evaluate its association with sociodemographic characteristics.

Methods: A cross sectional study (n = 266) was conducted using Google form from January to June 2022, using a validated questionnaire to evaluate the students' preference on online teaching, duration of online sessions, devices used, and perception on barriers of online teaching. Association between the preference on online teaching and sociodemographic factors was evaluated using Chi-square test.

Results: Majority (61.6%) preferred online teaching and preference was significantly higher among students from the Faculty of Computing and Engineering (69%) followed by Business and Management (68.8%) and the least preference was among those from Faculty of Medicine (43.3%) (p <0.05). A significantly higher level of preference towards online teaching was observed among Malaysian (64.8%) as compared to non-Malaysian students (42.1%) (p <0.05). Online teaching was significantly preferred among those using desktop (78.9%) and laptop (74.6%) as compared to those using mobile phone (53.3%) (p <0.05).

Conclusion: This study found that the students from non-medical faculties, of Malaysian nationality and those using desktops and laptops were showing significantly higher preference to online teaching. Students perceived that more interactions can improve the online teaching experience.

P505

ELEMENTS OF EFFECTIVE TEACHING FROM THE PERSPECTIVE OF ANATOMISTS

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Introduction: Previous evidence shows that effective teaching is highly dependent on the ability of educators in designing lesson plans and implementing engaging teaching strategies that ensures the attainment of learning outcomes. Nevertheless, there is a scarcity of empirical evidence of effective teaching in anatomy education sciences. Hence this study aimed to explore the elements of effective teaching from the perspective of anatomists.

Methodology: A qualitative study was carried out by using an in-depth interview involving ten anatomy lecturers from two public medical schools in Malaysia. The interview data were transcribed into electronic format and were analyzed using thematic analysis via the ATLAS.ti software.

Result: The analysis generated three themes, namely: (1) lecturer's personality and competency; (2) teaching approaches and strategies; and (3) teaching support. Each theme overlies several sub-themes that reflect a considerable number of effective teaching elements. There are twelve effective teaching elements generated. These include: (1) lecturer as motivator; (2) enthusiastic and competent lecturer; (3) lecturer attitude and aptitude (4) learning in group; (5) conduct teaching related activity; (6) lecturing strategies; (7) vertical and horizontal integration of knowledge; (8) alternative teaching approaches; (9) teaching strategies; (10) teaching autonomy and support; (11) supportive educational environment; and (12) teaching aid.

Conclusion: The finding of this study is important as a basis for producing guidelines for effective teaching and for producing the exemplary educator who can teach well in future.

P510

HOW GOOD IS ANATOMAGE TABLE IN LEARNING SURFACE ANATOMY?

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Introduction: Anatomage® is an interactive digital dissection table that is widely used in anatomy education. Previous studies have analysed student learning experiences using Anatomage; we now evaluated its reliability in identifying visceral structures using surface landmarks.

Methods: Four digital cadavers (Caucasian+Asian; male+female) in Anatomage were studied. Vertebral locations of structures at three anatomical planes (C6, T4 and L1) were reviewed. Also, surface projections of clinically and radiologically significant landmarks like umbilicus, inguinal rings, McBurney's point, diaphragm openings and vertebral level where the blood vessel arise from were evaluated. The findings were compared with surface anatomy literature in standard textbooks and research articles.

Results: Fundus of the gall bladder was present at L1 only in the Caucasian male model, that also showed the origin of oesophagus at C4. In both Caucasian male and female, the jugular notch and Louis angle varied by one vertebral level, and the appendix was absent, making McBurney's point unpredictable. Both female models lacked the thoracic duct and the cisterna chyli. In the Caucasian male and female, details of peritoneum and inguinal rings were underrepresented; they showed umbilicus at L5 level. Pylorus of Caucasian female was at L3.

Conclusions: There are considerable variations in the viscera, and thus the surface anatomy projections between the bodies used in Anatomage; a comprehensive use of the different bodies for specific regions will benefit students the most. These variations could be corrected in the future version, and any custom-made 3D digital anatomy application developed should adopt the standardised surface anatomy details.

P511

OESOPHAGEAL HISTOLOGY: QUEST FOR THE NORMAL FEATURES

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Introduction: Undergraduate histology teaching and learning method has tremendously changed with time. Students could now access histology images, digital textbooks, and recent histological findings online. Nonetheless, it is important to ensure students are getting the correct information from credible sources. In our department, despite the online digital histology related resources, our histology practicals require students to use microscopy skills in identifying normal histological features of human tissues using histology slides. Since most human organs are too large to be used in the slide preparation, animal tissues are the alternative resort. Thus, preparation of histology slides that show the normal characteristic features representing each human organ is vital. This study aimed to assess the normal histology features of oesophagus harvested from rats, rabbits, cats and monkeys to be used in the gastrointestinal module histology practicals.

Methods: 42 existing and new oesophageal tissue blocks from rats, rabbits, cats and monkeys were assessed in preparation of normal oesophagus slides for preclinical undergraduate medical students.

Results: Rats' oesophagus were found to have keratin on its epithelial lining surface. Oesophagus tissues from rabbits, monkeys and cats were found to have similar histological features as normal human oesophagus, with non-keratinised stratified squamous epithelium. However, there is a restrictions that prohibit and limit the use of cats and monkeys in animal study.

Conclusion: Although tissues from rats are easier to obtain, rats' oesophagus showed totally different features compared to humans'. Therefore, the best alternative tissue sources that could represent normal oesophagus histology could be obtained from rabbits.

P512

APPLICATION OF CASE BASED DISCUSSION ON IMPROVING LOWER LIMB ANATOMY KNOWLEDGE

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Introduction: Anatomical knowledge promotes students' learning in pathophysiology and underpinning the examination of a patient. Nowadays, many innovative teachings are introduced to encourage learning, knowledge retention, and clinical reasoning. Understanding the lower limb anatomy is essential in identifying nerve(s) injury of lower limb. Aim of this study is to determine the effectiveness of case-based discussion on improving lower limb anatomy knowledge.

Methods: Total of 117 year-2 MBBS students answered pre and post-tests of single-best-answer (SBA) questions. Additionally, in the same cohort, 126 students completed feedback on team discussion by using a validated questionnaire.

Results: The average pre-test score is 65.55 and the post-test score is 78.73. The pre-test score showed that 41.03% of students received less than 60%, 27.35% of students achieved >60 to 84%, and 31.62% of students are awarded >85-100%. Post-test score showed that 13.68% of students received less than 60%, 16.24% of students achieved >60-84%, and 70.09% of students are awarded >85-100%. There was not a significant difference between pre and post-test scores (*P-value* is 4.2). Moreover, 126 students responded the questionnaire relating to the perception of teamwork. 96% of students agreed that team discussion was very helpful and enhanced their motivation to study anatomy more interactively. However, 2.4% of the students replied neutral and 1.6% of the students reported a negative impact on their learning.

Conclusion: This preliminary study revealed that case-based discussion can improve their lower limb anatomy knowledge. This allows more interaction among peer students and to apply the knowledge in their clinical career.

P513

STUDENT LEARNING EXPERIENCE USING COMPLETE ANATOMY APPLICATION DURING COVID-19 PANDEMIC

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Introduction: Complete Anatomy is a virtual anatomy application that allows visualization of human body structures in 3-dimension. The new generation of medical students are accustomed to digital learning, which promotes greater flexibility and interactivity. Hence, the Complete Anatomy software was introduced as main teaching tool for anatomy practical session in the School of Medical Sciences, Universiti Sains Malaysia, during the COVID-19 pandemic. In this article, learning experience using the Complete Anatomy application during remote learning are described.

Method: Each anatomy practical class was performed online, with the lecturer displaying the Complete Anatomy application via teleconference tool. Simultaneously, the students accessed the application through their smartphones. Through the shared screen, the students were guided on navigating the human body structures by utilizing several unique features associated with these technologies. The opportunity to observe the 3D live model in their dimension allowed peer interaction during the practical sessions. A survey was done among the medical students.

Result: Out of 43 students who answered the survey, majority perceived that the application facilitates their visuospatial ability of human body structures. They were engaged in the virtual dissection and peer discussion activities despite learning remotely. The augmented reality features enhanced their understanding on surface anatomy, which is difficult to comprehend from a textbook illustration.

Conclusion: Complete Anatomy is a helpful tool in promoting students' visualisation of anatomical structures and active learning, in the absence of physical practical classes. Indeed, the application can be utilised as an adjunct tool to supplement the physical anatomy practical post-pandemic.

P514

STUDENT LEARNING EXPERIENCE USING VIRTUAL ANATOMY MUSEUM DURING COVID-19 PANDEMIC

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Introduction: Virtual Anatomy Museum (VAM) is an interactive website developed for Universiti Sains Malaysia (USM) medical students to learn Anatomy during the COVID-19 pandemic. This study aims to evaluate the medical student's learning experience using the VAM portal during the COVID-19 pandemic in learning Anatomy subject.

Methods: The VAM resembles the physical anatomy museum. It has forty labelled 360-degree images of anatomical models. Medical students are able to access the VAM at any time. Feedback from the medical students at the School of Medical Sciences, USM were collected through online questionnaire. The questionnaire covered five aspects: the experience of learning using the portal, the simplicity of navigation, the relevancy of the content, the ability to locate the essential information, and the benefits achieved by using this portal.

Results: Analysis of feedback from 39 respondents showed that 97.5% found the experience of using the virtual anatomy museum enjoyable. About 79.5% thought it was easy to navigate through this portal. The majority of respondents (92.3%) agreed that the content of this portal is relevant to them. About 94.9% agreed that they were able to find the information they were looking for from this portal. Some benefits of this portal were that the students could learn from the actual model used during practical class at any time, enhancing their understanding of anatomical structures.

Conclusion: The VAM features interactive elements that encourage students to learn anatomy engagingly and enhances the understanding of anatomical structures during the challenging time of the COVID-19 pandemic.

P516

STUDENTS' PERSPECTIVE OF HISTOLOGY MOBILE APPLICATION AS A SUPPLEMENTARY LEARNING TOOL IN ANATOMY

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Introduction: The abrupt transition from in-person to online learning during the COVID-19 pandemic had restricted the use of anatomy museum, dissection hall, and laboratory sessions during anatomy learning. The Anatomy Department of Universiti Sains Malaysia has developed 10 histology mobile applications of different topics. The aim of these applications is to facilitate students' remote learning and self-revision during the pandemic. To evaluate its usability, medical student were invited to share their experiences in utilising this application during remote histology learning.

Methods: The histology quiz mobile applications are downloadable from the Google Playstore application. After attending formal histology lectures and laboratory sessions, we completed the quizzes as our self-study. The applications contain customized questions, tissue and microscopic structures identification, multiple choice, True/False, short answer and matching questions. These mobile applications incorporate game-designed elements, namely reward system, immediate feedback and scoring points.

Results: Thirty students were selected to share their experience regarding the usage of histology mobile application. Analysis showed that most of the student experience a great satisfaction using the application. Additionally, the mobile application has made the histology learning enjoyable. The application is user-friendly as it is easy to navigate and permit multiple repetitions of the same questions. The questions were relevant to the learning outcomes of histology topics of the Medical Degree curriculum. Besides, we also used the mobile applications during online peer discussion.

Conclusion: Histology mobile application is an enjoyable supplementary learning aid for medical students. More digital applications should be introduced in the future to facilitate students learning.

P518

3D PRINTED NEUROANATOMY MODELS USING SOFT POLYMERS: A NEW INNOVATION PARADIGM IN ANATOMY EDUCATION

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Introduction: Three-dimensional (3D) visualization is imperative for acquisition of anatomy knowledge and appreciation of complex relationships between anatomical structures. Therefore, anatomy teaching requires the use of multimodal teaching aids, including anatomical models. The commercial plastic models are costly, inflexible and limited in their capacity to reflect structural accuracy and actual consistency of the structures. Therefore, this study aims to develop 3D printed neuroanatomy models using soft polymeric materials that can replicate real consistency of human anatomical structures.

Methods: Thermoplastic urethane (TPU), ethylene propylene diene monomer (EPDM) and styrene butadiene rubber (SBR) were used in material processing. Customized blended compounds were extruded into 3D printing filaments. Tensile properties (tensile strength, elongation at break, and Young's modulus) of TPU 85A, TPU 95A, TPU:EPDM, and TPU:SBR blends were characterized. A human brain MRI image in DICOM format was segmented by using 3D Slicer software to obtain regions of interest. The segmented brain structures were converted into STL format and edited in Autodesk Meshmixer software. The models were printed using Ender 3 3D printer.

Results: TPU 85A material, which was found to have the best tensile strength and elasticity, was used to fabricate 3D printed cerebrum, ventricles, Circle of Willis, and dural venous sinuses. The final products have softer consistencies than the commercial plastics models.

Conclusion: Customized soft polymer blends allow the development of 3D printed neuroanatomy structures that mimic actual consistency of the live human specimens. It is envisaged that this innovative idea can substitute the rigid plastic models to enhance kinaesthetic anatomy learning.

P519

STUDENTS PERCEPTIONS OF LEARNING ANATOMY USING THE RADIOLOGICAL IMAGING MOOC

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Introduction: Incorporating radiological imaging in anatomy can improve students' comprehension and facilitate three-dimensional (3D) visualization of anatomical structures. Nevertheless, radiological anatomy is given less emphasis in the undergraduate anatomy curriculum. The Coronavirus Disease (COVID-19) pandemic has led to rise in the use of Massive Open Online Course (MOOC) in anatomy education. This study describes the USM medical students experience on learning gross anatomy through a MOOC platform that incorporates radiological images as the instructional materials.

Methods: A MOOC platform known as the "Gross Anatomy Learning Using Radiological Images (GALERI)" was developed by a team of anatomy lecturers in the School of Medical Sciences, USM as a supplementary e-learning module during the pandemic. The GALERI focuses on anatomy of the thigh content. Medical students can learn to interpret thigh radiological images using tutorial videos, labelled MRI images and radiographs. The GALERI also includes interactive quizzes to assess the students' comprehension of the learning materials.

Results: 30 students perceived that GALERI had enhanced their understandings and knowledge of thigh anatomy. It also had helped them to develop the 3D visuospatial skill that allowed them to imagine the spatial relationship between the anatomical structures. Moreover, the students were able to appreciate the relevance and application of the anatomy knowledge for clinical practice.

Conclusion: The GALERI is a freely accessible and convenient online platform that is well-accepted by the medical students. Nevertheless, further work needs to be done to establish the effectiveness of GALERI in enhancing students' learning in anatomy.

P520

ENHANCING SURFACE ANATOMY COMPETENCY IN EARLY CLINICAL EXPOSURE TEACHING IN UNISZA

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Introduction: Experiential learning is important for deeper understanding, especially in application of anatomy knowledge. Early clinical exposure (ECE) is a teaching and learning approach that allows preclinical medical students to apply theoretical knowledge in a clinical context before their clinical postings. This is an experience-sharing on how surface anatomy was emphasised during ECE session in UniSZA's medical programme. The feedback was aimed for future teaching improvement.

Methods: It was an observation on how ECE session was conducted and a qualitative study on students' feedback. The cardiovascular (CVS) session was chosen, involving Year 1 medical students in three subgroups (20 students per group). The feedback forms with an open-ended question on their opinion were given at the end of the two-hour session.

Results: The ECE was conducted in the clinical skills laboratory using a small group setting. A case scenario was provided for students to perform a praecordium examination on a mannequin. The hands-on activities included were inspection of the chest, palpation of the apex beat and auscultation of heart sounds and murmurs in mitral, tricuspid, pulmonary and aortic areas. Thus, they should apply the surface anatomy knowledge of the chest during the physical examinations. The feedback revealed benefits of ECE teaching namely provide meaningful clinical exposure and promote clinical application and understanding of knowledge. However, its drawbacks were inadequate hands-on practice and time in teaching.

Conclusion: ECE is an excellent platform to integrate anatomy concept with clinical application; hence promote understanding and enhance competency on surface anatomy, but further improvement and studies are required.

P521

VIRTUAL REALITY IN ANATOMY EDUCATION: ADVANTAGES AND CHALLENGES

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Introduction: Anatomy education has evolved throughout the centuries. In the latest decade, anatomy educators encountered different challenges from limited number of cadavers, high-priced anatomical plastination and models. Recent COVID-19 pandemic has inevitably mold future anatomy pedagogy to better-adapt with the current digital-savvy generation. Despite the emergence of virtual reality (VR) in anatomy teaching & learning (T&L), there is limited comparative analysis being explored. Hence, this study aims to elucidate the advantages and challenges using VR in anatomy education.

Methods: A narrative review was conducted for this study. Research question was formulated and bibliographical search performed using Scopus and Science Direct databases. Experimental studies published between 2010-2022, in English language, discussing on application, advantages or disadvantages of VR in anatomy and medical T&L were analysed.

Results: A total of twenty-four research articles were retrieved. The literatures suggest VR in anatomy education is beneficial as it is more realistic, hands-on, enhances visualization and enjoyable self-learning tool that increases learners' engagement. This is especially in low-spatial ability learners that has difficulty to visualize the location and dimension of anatomical structures. VR may improve teaching effectiveness and level of anatomy knowledge. However, the disadvantages are high-cost equipment and risk of tools malfunction. Some experiencing extraneous cognitive load in learning new modalities, motion-sickness, and headache after using VR headgear.

Conclusion: The advantages of VR in anatomy education are extensive and outweigh the challenges. As VR devices are more affordable, the current challenge has moved to exploring ways to utilize this advancement in anatomy teaching effectively.

P522

SHIFT FROM AUDITORY TO VISUAL LEARNING – IS IT THE NEED OF THE HOUR FOR PRECLINICAL MEDICAL STUDENTS?

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Introduction: Preclinical medical students predominantly follow an auditory-based learning style in a classroom. However, the highest proportion of learning style among clinical years' medical students is dominated by visual learning. This instantaneous challenge to a different pattern of learning style and their inadequacy to adapt alarmingly impacts their academic performance, clinical interpretation, and disease diagnosis skills.

Methods: At Quest International University, preclinical 2nd year medical students participate in an interdisciplinary symposium (IDS) in small groups (n=7 to 10) at the end of each system module. System-related clinical condition is allotted as the presentation topic. Relevant preclinical and clinical concepts pertaining to the topic were presented (role play, powerpoint presentation). Their performance was evaluated by a team using a questionnaire. Out of the total three IDS, two were presented in regular powerpoint presentation mode which was non-diagram-based visual learning (NDVL). One IDS on the respiratory system was presented using only diagram-based visual learning (DVL). Kruskal-Wallis test compared the learning styles and efficacy was evaluated.

Results: The average scores obtained in the DVL (38.14 ± 1.35) was significantly higher than the NDVL styles (33.00 ± 1.86) ($p=0.002$). The individual performance score of each student significantly improved in DVL than NDVL.

Conclusion: Our study reported three major conclusions (i) IDS is an adept platform for exploring different learning styles. (ii) Visual learning style improves students' academic performance and is highly preferred over the auditory method (iii) Change in the learning style is the immediate need of the hour among preclinical medical students.

P524

DISSECTION AND USE OF CADAVER IN ANATOMY AND MEDICAL EDUCATION: THE ISLAMIC VIEWPOINTS WITH SPECIAL REFERENCE TO MALAYSIA

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Introduction: Cadaveric dissection has been an important component in anatomical and medical education throughout the centuries. One important medical textbook in history, 'De humani corporis fabrica, published in 1543 based on human dissections. Earlier Muslims in the Islamic Golden Age have significantly contributed to the development of medicine and surgery, including anatomical research. However, the use and dissection of the human body have elicited ethical concern across different religions including Islam. With the availability of various software and applications such as 3D animation as potential alternatives, it is therefore timely to revisit the Islamic views regarding dissection of human body for medical education.

Methods: A narrative review was conducted for this study using various search engines and databases. Articles published between 2000-2022 that discussing the Islamic and ethical issues of human cadaveric dissection in anatomical and medical education are selected. Policy papers published by relevant authorities were also included. Major ethical issues related to human cadaveric dissection and their implications to Islamic legal principles were analysed.

Results: A total of 60 relevant articles were retrieved from the bibliographical search and analysed. The following major issues are identified: the sanctity and necessity of cadaver dissection in medical education and different views among Muslim scholars and authoritative bodies.

Conclusion: There are two views on the use of dissected human cadaveric in anatomical and medical education. According to the majority Muslim scholars and relevant authoritative bodies, it is generally permissible based on *qiyas* methodology, principles of necessity, and certain *qawa'id fiqhyyah*.

P525

OBSERVATION ON THE EFFECTIVENESS OF FLIPPED CLASSROOM (FC) IN TEACHING ANATOMY AT NEWCASTLE UNIVERSITY MEDICINE MALAYSIA: A PRELIMINARY STUDY

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Introduction: Flipped Classroom is a student-centred approach which enhanced students' engagement in anatomy and promotes academic achievement. Several preliminary studies have been conducted to evaluate the effectiveness of the FC but there are discrepancies between their results. This preliminary study aims to observe student's responses on FC in anatomy teaching at Newcastle University Medicine Malaysia (NUMed).

Methods: The study uses a qualitative exploratory study that explored students' experiences using a FC without hands-on cadaveric sessions in Anatomy Practical. The anatomy teaching in NUMed involved face-to-face briefing with small group discussions. Online materials including the 3D human anatomy software (3D apps), live streaming of cadaveric sessions from the UK campus, videos, and self-explanatory tutorials were supplied before the practical session. At the end of the practical session, spotters were conducted, and free text comments were collected.

Results: The results indicated that the anatomy practical with the FC and the 3D apps was enjoyable and productive. It was described as a good session where the lab briefing helped students to recap the topic and the spotters stimulated them to do the revision. The peer teaching activities in a small group discussion have encouraged students to divide the learning outcomes amongst themselves and teach the rest of the group using the models and the 3D apps. However, there were also feedback from students who preferred hands-on experience with cadaveric dissection.

Conclusion: FC stimulates the students to learn anatomy in an interactive way and achieves the learning outcomes despite of the absence of the hands-on cadaveric sessions in NUMed.

P526

INTEGRATION OF ONLINE ANATOMY EDUCATION USING “DEBUG” GUIDELINES TO FACE-TO-FACE LEARNING AFTER COVID-19 IN NUMED: A PRELIMINARY STUDY

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Introduction: Newcastle University Medicine Malaysia (NUMed) has established a guideline called “Debug” to develop and assist anatomy educators in positively designing online anatomy learning. The guideline successfully enhanced the quality of online teaching during Covid 19 pandemic. However, the effectiveness of online teaching approaches as a supplement during face-to-face teaching sessions after Covid-19 were not understandable. Therefore, the study aims to explore the potential of integrating online anatomy education as supplement during face-to-face teaching sessions post pandemic.

Methods: A qualitative explorative study was conducted using students experience on aided multimedia resources such as 3D Complete Anatomy app, live streaming of cadaveric session from UK campus, and self-directed online tutorial. These teaching materials were provided prior to face-to-face laboratory session. The students who participated in the study are Year 2 MBBS students. At the end of the laboratory practical session free text comments were collected and analysed as feedback for that session.

Results: Overall, the free text comments indicated that the students had a positive experience regarding the integration of online anatomy education before face-to-face laboratory session. They describe the session as “on the right track”, “enjoyable and productive”, and “educational”.

Conclusion: The integration of online anatomy education using “Debug” guidelines has tremendously improved the student’s preparation and understanding of anatomy before their face-to-face laboratory session. Future studies could explore the specific areas of improvements to influence planning and teaching session.

P527

FUN WAY OF LEARNING HISTOLOGY USING POWERPOINT GAME

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Introduction: Traditionally in histology subject, students are expected to understand the fundamental knowledge during lectures and acquired skills to identify the tissue during practicals. However, as a challenging subject that requires students' imagination, it may lead to loss of interest. Gamification in which games were created as learning tools, has been used by educators from various levels of the education system to engage students' interests. The aim of this study is to determine whether PowerPoint game influence students' motivation to study histology subject.

Methods: An interactive game was developed using PowerPoint software. The theme of the game is adventurous, where students can start exploring at any point of their interest. The questions embedded within the game are based on exam format and learning outcomes. Correct answers will be awarded tokens, while wrong answers will be penalized. Collected tokens are needed to finish the game. Effectiveness of the game was measured based on students' perceptions.

Results: Feedback from 43 respondents shows majority, 93%, agree that PowerPoint game is an exciting platform for gamification. Most prefer to have more games like this as additional tools in learning histology, represented by 95.3% of respondents. More than half of respondents, 65% strongly agree while only 11.6% strongly disagree that gamification boosts their motivation to study.

Conclusion: PowerPoint game provides an exciting platform to engage students' interest in learning histology subject. Hence, it can increase their motivation to study and may improve their understanding of histology subject and can be used as additional learning tools.

P528

STUDENTS' EVALUATION ON THE HISTOLOGY QUIZ MOBILE APPLICATION IN SCHOOL OF MEDICAL SCIENCES, UNIVERSITI SAINS MALAYSIA

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Introduction: The COVID-19 pandemic has triggered the shift from face-to-face to online learning. To facilitate students' self-study during the pandemic, the Department of Anatomy, Universiti Sains Malaysia has created ten histology mobile applications on various histology topics. Each application consists of at least 50 customized questions. This study aims to evaluate the pre-clinical medical students' satisfaction level with the application.

Methods: Anatomy lecturers contributed the content of the quiz, while the medical laboratory technologists prepared the digital hand-drawn diagrams. The mobile applications were developed using an online puzzle builder software, Quick App Ninja. These mobile histology applications were launched in 2021 and are available on the Google Playstore application. The pre-clinical students were encouraged to install and use the applications after attending online lectures and practical sessions of the related topics. At the end of the academic session, feedback from the 96 pre-clinical year students were obtained through online questionnaire to evaluate their satisfaction on four constructs: (1) coverage of the content, (2) content delivery, (3) learning motivation and (4) perceived knowledge from the use of the application.

Results: The analyses revealed that more than 93% of the students were satisfied with the application. The mean scores for all four constructs were more than 4, indicating high satisfaction level.

Conclusion: The Anatomy Online Quiz application is a promising tool in stimulating learning motivation and perceived knowledge acquisition. Nevertheless, future studies are required to assess the effectiveness of the mobile application in promoting students' histology learning.

P529

EFFECTIVENESS AND PERCEPTION OF QUICK RESPONSE (QR) CODE LEARNING TOOL 'OHH MY JOINTS! (OMJ!)' IN UNIVERSITI PUTRA MALAYSIA

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Introduction: QR code usage is very common nowadays due to its quick readability and easy accessibility. We invented a picture with QR code as an e-learning tool, called 'OHH MY JOINTS! (OMJ!)', to study the human joints for the target audience of the medical and health sciences students in Faculty of Medicine and Health Sciences (FMHS), Universiti Putra Malaysia (UPM). CT scan films were added in OMJ! to emphasize and provide a clearer view of the normal joints. In this study, we assessed the effectiveness and perception of the OMJ! as an e-learning tool to study human joints among the medical and health sciences students in FMHS, UPM.

Methods: Cross-sectional study was conducted using a convenience sampling method. Google Meet sessions were conducted among participants within 15 - 20 minutes to study the OMJ! learning tool. Self-administered pre-research and post-research questionnaires were distributed.

Results: Results revealed that students had statistically significant ($p < 0.001$) higher levels of knowledge regarding the musculoskeletal joints after using the OMJ! learning tool while 93.0% of the respondents perceived the OMJ! learning tool in a positive manner.

Conclusion: QR code OMJ! e-learning tool is very simple, easy to use, cost- and time-effective, with enough knowledge that could be delivered in a timely, organized, and efficient manner. The OMJ! is an effective way to study joints of musculoskeletal system and was perceived well among medical and health sciences students in FMHS, UPM.

P534

MEANING OF THE SKULLS DEPICTED IN EMBLEM BOOKS OF THE 17TH CENTURY

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Introduction: This study aims to elucidate the meaning of the skulls depicted in emblem books of the 17th century.

Methods: Three emblem books of the 17th century were reviewed and analyzed: 1. Rollenhagen emblem: *Gabrielis Rollenhagenii Selectorum emblematum centuria secunda* (1613), 2. Quarles' emblems; illustrations engraved by William Marshall and others (1635) 3. Wither's emblem: *A collection of emblems, ancient and moderne: quickened with metrical illustrations, both morall and divine: and disposed into lotteries* (1635).

Results: Among the 100 illustrations of Rollenhagen's book, 4 (4.0%) had skulls. Among the 76 illustrations of Quarles' book, 6 (7.9%) had skulls. Among the 256 illustrations of Wither's book, 12 (4.7%) had skulls. Thereafter, 22 (5.1%) of 432 illustrations had skulls. Four emblems in Rollenhagen's book were identical to those in Wither's book. Therefore, 18 emblems (6 Quarles' emblem, 12 Wither's emblem) were analyzed. The most frequent meaning of skulls in 18 emblems was death (12, 66.7%), followed by resurrection (2, 11.2%). Other meanings were grief, the brevity of life, vanity of love, and pain, respectively (1 each). The most frequent theme of the emblems which including skulls were 'Memento mori' (remember death, 6, 33.3%), followed by (remember death, 6, 33.3%), followed by an earnest desire for salvation or resurrection (3, 16.7%), and the importance of knowledge or learning (2, 11.1%).

Conclusion: Since these emblem books were published after Vesalius' *Fabrica* (1543), the drawing of the bones of the arm and legs had anatomical correlations. However, skulls were not sufficiently precise, showing each part of the facial bones.

P603

PREPARATION OF HUMAN SKULL USING DERMESTID BEETLES

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Introduction: There are many methods to preserve good human bone specimen. The best method in preparing human bone specimen is by using dermestid beetles. This study aims to describe the methods of human skull specimen preparation using dermestid beetles.

Methods: A colony of mature dermestid beetles was reared in glass container. A fresh frozen Caucasian cadaveric head specimen donated by the Department of Otorhinolaryngology-Head and Neck Surgery, Universiti Sains Malaysia (USM) was thawed in warm water (40°C). The head specimen was dissected to remove the skin, muscles, brain and soft tissues. A little amount of muscles and soft tissue were left attached to the specimen for the beetles to feed on. The specimen was placed in a glass container covered with mosquito net containing the colony of dermestid beetles and kept at room temperature in low ambient light room. A video camera was used to record the activity of dermestid beetles consuming the tissue of the head specimen. After three weeks, the specimen was immersed in alcohol chloroform solution at room temperature to remove the residual fat.

Results: The final product of the skull produced no irritating nor unpleasant odour. It was completely devoid of soft tissue. It did not show any signs of bony erosion or defects. The minute structures of skull such as foramina, grooves and suture lines were well-preserved.

Conclusion: The preparation of cadaveric human skull specimen was successfully achieved using dermestid beetles. This has reduced the use of toxic solutions and results in better quality human bone specimens.

P604

TAKAYAMA TEST TO DETERMINE CLEANLINESS OF AUTOPSY TABLE AFTER POST-MORTEM PROCEDURE

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Introduction: Autopsy is a procedure done by doctors when a person died to access the cause of death. This procedure is routinely done in hospitals in the occasion of accidents, foul play, suicides, suspicious of murder as well brought in dead. During the autopsy, the body will be placed on steel table and the procedure will be done. Once the procedure finished, the table will be cleaned and the cleanliness of the table from contamination raised the doubts of the integrity of the procedure. The aim of this study to determine the best cleaning to eliminate the post- mortem table from contamination.

Methodology: In this study, blood samples were obtained from the blood bank which was rejected due to various reasons. The blood samples were applied thoroughly across the autopsy steel table, with the dimension of 2000 x 700 x 450mm. The blood was left to dry for period of 2, 6 and 9 hours apart. The table surfaces were washed with three different cleaning detergents and water with or without bleach. Afterwards, the surfaces were tested using Takayama test to determine the presence of blood after the wash.

Results: From this study, the usages of bleach together with powder detergent shows no cross contamination compared to using water wash only as well liquid detergent wash and powder detergent alone.

Conclusion: The usages of combination of bleach and powder detergent is the most effective way to eliminate cross contamination and to improve the cleaning procedure in the post-mortem table and maintain the integrity of evidence.

P701

METRIC AND NON-METRIC TRAITS OF THE FEMUR IN A CONTEMPORARY SRI LANKAN POPULATION

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Introduction: Skeletal features have been valuable in assessing the affinities of human populations because there is subtle variation among worldwide data in relation to different populations and different historical ages. The main objectives of the present study were to s.

determine metric and non-metric variations of the femora in a contemporary Sri Lankan population and to compare the data with those of other world populations.

Methods: A total sample of 130 completely ossified dry femora of known sex and age was used. Each femur was studied for both metric and non-metric traits. A single investigator measured and recorded nine metric variables and six non-metric traits to minimize inter-observer error. Intra-observer error was also excluded. Ethical approval for the study was obtained from the Ethics Review Committee, Faculty of Dental Sciences.

Results: All the average measurements except midshaft transverse, subtrochanteric antero-posterior and subtrochanteric medio-lateral diameters were significantly larger in males than females both in left and right sides. Out of non-metric traits observed highest prevalence was determined in the third trochanter (46.88%), followed by exostosis in trochanteric fossa (31.03%) and Poirier's facet (28.85%). Meanwhile, the lowest occurrence was observed in hypotrochanteric fossa (15.38%).

Conclusions: The present sample showed lower prevalence of Fossa of Allen and Poirier's facet compared to the Nigerian population. In Indians, the prevalence of the third trochanter is much lower (6.6%) than in Sri Lankans. The present study reveals that the femur morphology is highly variable among populations and affected by several environmental and genetic factors.

P705

IMPROVEMENTS IN THE HEMIPARETIC LOWER LIMB CIRCUMFERENCES IN STROKE PATIENTS FOLLOWING ROBOTIC REHABILITATION

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Introduction: Increment of stroke survivors leads to the increment of chronic stroke patients suffering from hemiparesis in neurorehabilitation facilities. Hemiparetic muscles benefitted from the consistency of high-intensity, repetitive, and task-specific therapy offered by robotic rehabilitation apart from conventional rehabilitation alone. Therefore, this study aimed to compare the circumferences of the muscles following conventional versus robotic rehabilitation.

Methods: Conventional rehabilitation (CR) participants (n=10) and robotic rehabilitation (RR) participants (n=10) who suffered from stroke underwent a five-day-a-week rehabilitation program for a one-month duration. CR received home-based therapy with three sessions of periodic follow-up at the facility. RR received conventional rehabilitation with the fusion of robotic therapy using the HAL® Cyberdyne for lower limb. The mid-thigh and mid-calf circumferences were measured at specific time intervals from baseline until the completion of four weeks of therapy.

Results: A total of 20 data were analysed, and some degree of increment of the mid-thigh and mid-calf circumferences was seen in both paretic and non-paretic mid-thigh and calf circumferences. The improvement of the circumferences was more significant in the RR participants as compared to the CR.

Conclusion: Significant increment of the muscle circumferences following robotic rehabilitation was seen in the stroke patients. Ultrasound, CT scan and DEXA scan may be beneficial in eliminating the intramuscular fat mass and giving more accurate data on certain muscles. Hence, this study may provide some insights into further potential research on stroke.

Trial Registration: Ethical approval from Universiti Sains Malaysia Human Ethics Research Committee (JEPeM): USM/JEPeM/21090603

P706

A SYSTEMATIC REVIEW ON SEX DETERMINATION USING HUMAN RIBS VIA ANTHROPOMETRIC MEASUREMENTS

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Introduction: As the skeleton used for sex estimation may be missing or damaged due to trauma or the nature of the incident, the information on the sex must be sought after from many skeletal remains, including human ribs. Various research explored the usage of different anthropometric methods using human ribs for sex determination. Thus, this review summarized the significance of different anthropometric approaches on a different level of ribs and populations to determine sex.

Methods: A comprehensive search was performed using PubMed, Science Direct and Google Scholar from 2000 to 2020 using Preferred Reporting Items for Systematic Reviews and Meta- Analyses (PRISMA) criteria. All the search used the following keywords (and its synonyms) in combination: (i) anthropometry (ii) sex (iii) human ribs. The inclusion criteria include the report of the anthropometry method used and involvement of any form of anthropology tools such as digital calliper, X-ray or CT scan. The literatures were reviewed in 3 phases and 2 reviewers were assigned to review each paper.

Results: Out of 1299 articles, 10 articles matched all inclusion and exclusion criteria and were selected for review. Data such as populations, level of ribs, method, intervention, and outcome were extracted. We have found a significant difference between sex using human ribs. The geometric morphometric method exhibited a greater degree of sexual dimorphism among all the methods used.

Conclusion: This review demonstrated the effectiveness of human ribs in determining the sex. However, further studies using meta-analysis are needed to compare the most reliable method for sex determination using ribs among various anthropometric measurements.

P801

A CADAVERIC STUDY OF ANATOMICAL VARIATION OF SPHENOPARIETAL SINUS & SUPERFICIAL SYLVIAN DRAINING VEINS IN SABAH POPULATION

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Background: The term "sphenoparietal sinus" was coined by Gilbert Breschet in an atlas of the venous system in the early nineteenth century. Since then, many literatures have gained interest in knowing the sinus and the drainage. Drainage of superficial sylvian veins was consistent in many literatures however controversies exist. This study was aimed to delineate the microsurgical anatomy and variation of the sinus and sylvian draining veins.

Methods: 30 fresh cadavers were examined in Forensic Department Queen Elizabeth Hospital between October 2020 to October 2021, and were anatomically analysed and studied through a data collection sheet.

Results: The studied cadavers were 76.7% male (n=23) and 23.3% female (n=7). All cadavers (100%, n=30) had Sphenoparietal sinus (SPS) on both side and all draining to ipsilateral cavernous sinus. Number of Superficial sylvian draining veins (SSDV) varied from 0 veins up to 4 veins on both hemispheres. Based on cadaveric data, we have formulated new classification of SPS-SSDV drainage based on number of draining veins.

Conclusion: We observed the presence of SPS and variance in numbers of draining veins to SPS. These new classifications of SPS-SSDV complex will provide a new microsurgical nomenclature for future use in neurosurgery and neuroanatomy.

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MATERNAL AND DEVELOPMENTAL TOXICITY EFFECTS OF ACUTE XYLENE EXPOSURE IN SPRAGUE DAWLEY RATS

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Introduction: Xylene is widely used in medical laboratories and is considered a safe alternative to benzene. Nevertheless, concerns have been raised about the effects of xylene exposure at the ambient level on pregnant lab personnel. Therefore, this study aimed to investigate the toxicity effects of xylene on maternal and foetal parameters.

Methods: Sprague Dawley rats (8-week-old) (n=6 per group) were treated with 100, 500 and 1000 ppm of technical xylene via intraperitoneal injection from gestational day (GD) 6 until GD17, followed by caesarian section at GD21. The samples were weighed, examined, fixed and stained with Haematoxylin & Eosin, Von Kossa and Periodic Acid Schiff for further analysis.

Results: 1000 ppm-treated group showed a significant ($p<0.05$) decrease in maternal body weight (BW), corrected weight gain and food intake, and increased intrauterine deaths (11/277). All xylene concentrations caused a significant ($p<0.05$) decrease in the placental weights of the male foetuses. However, only placentae of the 1000 ppm-treated group ($p<0.01$) were affected in females. Moreover, male and female foetal BW was significantly ($p<0.01$) reduced in 500 and 1000 ppm-treated groups. This is consistent with an increased count of glycogen cells in placentae of the same groups. Histological examination also revealed marked uterine inflammation and necrosis in the xylene-exposed dams.

Conclusion: Xylene exposure during vulnerable gestational period can adversely affect pregnant rats and foetuses via in-utero inflammatory responses, of which the foeto-placental dynamic was affected. The research findings can be adapted to improve our current guidelines to safeguard maternal and foetal wellbeing during pregnancy.

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THE DEVELOPMENT OF A THREE-DIMENSIONAL CERVICAL SPONDYLOTIC MYELOPATHY FINITE ELEMENT MODEL AND MEASUREMENTS OF ITS MECHANICAL AND FLUID DYNAMICS: PRE-TESTING

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Introduction: Cervical spondylotic myelopathy (CSM) is a spinal cord dysfunction caused by degenerative changes which affect the vertebral canal and spinal cord especially in severe cases. This study aims to examine the pressure in the vertebral canal and the cerebrospinal fluid (CSF) flow between a normal cervical spine and a CSM spine using finite element method.

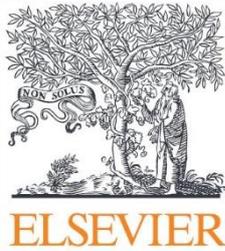
Methods: Two 3-dimensional (3D) patient-specific finite element (FE) models were developed; one for a normal spine and one for a CSM spine. The morphological parameters were observed and the changes in pressure on the spinal cord, the pressure of the CSF including the CSF flow of both 3D FE models were examined.

Results: In the 3D FE CSM model, there was a decrease in height of the vertebral body and osteophyte formations from C3 until C6 vertebrae. The average pressure on the spinal cord of the 3D FE CSM model was 3.89% higher, the pressure of the CSF was 4.29% higher and the CSF flow was 6.06% slower compared to the normal spine model.

Conclusion: The finite element method was able to examine morphological parameters, pressure on spinal cord, pressure in the vertebral canal and the cerebrospinal fluid (CSF) flow between a normal cervical spine and a CSM spine. The method used in this study and baseline measurements obtained will be useful for surgeons to assess individual treatment plans for CSM patients. Furthermore, the 3D FE model also can be used as an educational tool for advancement in teaching and learning gross anatomy.

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