Dr. Abbas Shafiee

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Biography

Dr. Abbas Shafiee is a tissue engineering & regenerative medicine scientist interested in translational cell-based and tissue engineering strategies to treat human diseases.

Dr. Shafiee completed his PhD at The University of Queensland on stem cell biology. His research career during his PhD had key contributions to delineating endothelial niche and vascular stem cells in the human placental tissues, including the seminal discovery of an entirely new stem cell population, coined as 'Meso-Endothelial Bipotent Progenitor' and the identification of key driver signatures for endothelial and bipotential progenitor function.

Then, he joined the Queensland University of Technology as postdoctoral fellow and conducted multiple projects on cancer and bone tissue engineering. Dr. Shafiee has developed innovative tissue engineered models intersecting concepts from stem cell biology, cancer, and tissue engineering to study species-specific cancer bone metastasis at an unprecedented level of detail. Utilizing the tissue engineering concept, he was able to better understand the mechanisms of human cancer bone metastasis. Additionally, he successfully developed a biomimetically designed scaffolds and investigated the interactions of multipotent mesenchymal stem/stromal cell and skin progenitors with 3D printed scaffolds. The application of 3D printed constructs in acute wound models decreased wound contracture and led to a significantly improved skin regeneration.

Dr. Shafiee joined Metro North Health (MNH, Queensland Health) in 2020 and started a research program to develop, implement, and evaluate the applications of 3D printing, scanning, cell therapies, and biofabrication technologies in skin wound settings, and dermatology research. Using the 3D printing and organoid technologies he could develop new approaches to enhances physiological wound closure with reduced scar tissue formation and advance the dermatology research. His groundbreaking organoid research resulted in establishing an international Consortium of Organoid Research in Dermatology, leveraging organoid technology to advance the understanding and treatment of genetic skin diseases.

Human Skin Organoids with Functional Appendages and Vascular Networks

Abbas Shafiee
Metro North Health and The University of Queensland

A large amount of research has been devoted to developing skin organs for studying developmental pathways, modelling diseases, or regenerative medicine purposes. Despite progress, the field is still far from fulfilling its dream of creating skin appendages, such as hair follicles and sweat glands.

Here, we present a pioneering approach for engineering stratified skin layers with their appendages using human induced pluripotent stem cells (hiPSCs)-derived skin organoids (SKOs) from three distinct hiPSCs lines. Our protocol induces the formation of hair placodes around Day 65 of differentiation, maturing into hair follicles by Day 83, aligning closely with human skin development timelines. Comprehensive analyses confirm the presence of several skin stem/progenitor populations such as dermal papilla cells in mature SKOs (Day 120 of differentiation). Additionally, our SKOs can develop sebaceous glands, sweat glands, fat, and touch-receptive Merkel cells, highlighting their complexity and fidelity to native human skin.

To further enhance physiological relevance, we investigate the vascularization of human SKO using hiPSCs-derived vascular progenitors. This approach results in fully vascularized SKOs, sustaining hair follicle formation and demonstrating the integration of CD45+ immune cells, thereby replicating the *in vivo* skin microenvironment. The generation of both immune cells and vascular components within the complete-appendage SKO mimics the structure of *in vivo* skin and represents a substantial leap forward, setting a new benchmark for translational skin research.

These human SKOs demonstrate substantial translational potential and could be used as valuable platforms for advancing dermatological research, understanding skin development, modelling diseases, and advanced regenerative solutions and personalized medicine.

Professor Chamindie Punyadeera FTSE,GAICD,GCLead

Professor and Inventor

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Biography

Prof Chamindie Punyadeera is an inventor, a fellow to the Australian Academy for Technological Science and Engineering (ATSE). She is an ambassador to women in STEMM. She has had a hybrid research career working in industry as well as in academia. She heads the saliva and liquid biopsy translational laboratory at Griffith University in Brisbane. Her laboratory develops biomarkers from concept through to commercialisation. She has pioneered the application of saliva-based tests and made groundbreaking discoveries that has led to the world-first detection of an occult HPV driven oropharyngeal cancer in a healthy person. Her research into saliva-based test (CancerDetect) to early diagnose and predict head and neck cancer, received FDA approval under breakthrough device designation for her industry partner in 2021. She has authored >153 research papers including Nature Materials, Clin Chem, 8 book chapters, 20 PCT, including one granted patent. She currently receives research funding from the NHMRC, ARC, Philanthropy and industry. She is a grant reviewer for both national and international funding agencies and currently serves on the Editorial Board of the Journal of Oral Oncology, associate editor BMC Genomics and a guest editor to BMC Medical Genomics, Diagnostics and Biomolecules.

Next Generation of Saliva Based Diagnostics for Disease Detection

The global incidence of cancer and chronic diseases is rising, with a significant number of cases occurring in rural and remote communities and in developing countries. Access to healthcare is often limited in these areas, creating a disparity for those affected. Point-of-care (PoC) testing can help bridge this gap and improve healthcare access for underserved populations.

Heart failure (HF) is a worldwide problem of epidemic proportions and is projected to rise with a growing and ageing population. About 50% of patients with HF will die in 5 years. Therefore, there is an urgent need for approaches that allow risk stratification of HF patients who are more likely to be re-hospitalised or have poor outcomes.

Oral cancer (OC) presents a critical global public health challenge and kills roughly one person every hour of every day. Alarmingly, up to one-third of OC cases stem from the malignant transformation of oral epithelial dysplasia. Current approaches to OC diagnosis rely on invasive biopsies, which only provide pathology information from a localised biopsied area, hence missing cancer, and necessitating additional diagnostic testing.

We have developed two biosensors for the management of patients with HF and OC: (a) a paper based PoC utilizing screen-printed carbon electrode (SPCE) to quantify Galectin-3 levels to predict outcomes in patients with HF. The paper based PoC was able to detect Galectin-3 with a limit of detection of 9.66 ng/mL, within a clinical setting. (b) Our electrochemical biosensor was able to detect miRNA-7-5p at a concentration of 1 pM, demonstrating its sensitivity. Furthermore, we found that patients with high-grade dysplasia have a significantly greater risk of developing OC compared to those with low-grade dysplasia (p=0.004, Tukey's HSD)

Biosensors that detect Galectin-3 in saliva have the potential to revolutionize HF care. PoC testing for miRNA in saliva using electrochemical methods provides timely risk assessments, allowing for early intervention and personalized treatment. This could lead to fewer hospitalizations and improved patient outcomes. Additionally, the simplicity of these tests promotes better patient compliance and monitoring, enhancing HF management and reducing healthcare costs.

Professor Chengtie Wu

Director and Professor

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Biography

Dr Chengtie Wu, is the Professor in Shanghai Institute of Ceramics, Chinese Academy of Sciences. He is the director of the Suzhou Institute of Biomedical Engineering and Technology, Chinese Academy of Sciences. Prof. Wu is mainly engaged in the research of biomedical materials and implantable medical devices and has won the National Fund for Outstanding Young Scholars of China, and the Humboldt scholars of Germany.

He is currently the Co-editor in chief for *Biomedical Engineering Frontiers*, associate editor for "*Applied Materials Today*", "*Microstructure*", and the editorial board member of *"Acta Biomaterials"* and *"Bioactive Materials"*. He edited two books and participated in the writing of 11 chapters of the English monographs. More than 300 SCI papers have been published in internationally famous journals such as *Advanced Materials, Materials Today, Science Advances, Biomaterials*, *Matter, National Science Review* with H index 92 (Web of Science search). He has been selected by Elsevier in the list of highly cited scholars in China from 2015 to 2023 for 9 consecutive years. A total of 70 patents have been applied for, and 30 Chinese patents and 2 American patents have been granted, of which 25 patented technologies have been transferred to the company.

He won the Fellow of the International Union of Biomaterials Societies, Journal of Materials Chemistry - Lectureship Award of the Royal Society of Chemistry, the IUMRS Young Scientists Award of the International Materials Association, the Outstanding Young Scientist Award of the Chinese Biomaterials Society, the Young Scientist Award of the Chinese Ceramics Society, and the First Prize of Science and Technology of the Chinese Biomaterials Society.

3D Printing of Biomimetic Biomaterials: From Fundamental Study to Translational Application

Chengtie Wu

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3D printing technology is one of the most promising technologies in the fields of tissue engineering and regenerative medicine, which can stack multiple components (materials, cells, etc.) layer by layer in three-dimensional space to construct complex and accurate structures. Therefore, for the construction of tissue regeneration scaffolds, 3D printing methods have far surpassed other traditional manufacturing methods. How to construct personalized tissue regeneration scaffolds with different compositions, structures, and functions through smart design and 3D printing technology is a research focus in the field of regenerative medicine. We have conducted a series of research work to meet the needs of biomimetic and functional 3D printing scaffolds, from material design, structural regulation, functional modification, and multi cell printing of artificial tissues. We have developed various 3D printing tissue regeneration scaffolds with excellent biological functions. Firstly, we prepared a series of biomimetic scaffolds with excellent tissue repair performance by regulating the macro/microstructure of 3D printed scaffolds. Macroscopically, through precise model design, printing out scaffolds with biomimetic lotus root and natural bone multi-level structures can effectively promote vascularized bone regeneration. At the micro level, by combining microbial catalysis and other technologies with 3D printing technology, a 3D printed scaffold with a specific micro nano structure is constructed, significantly improving the osteogenic performance of the scaffold. For tissue defects caused by diseases, scaffolds with a single repair function cannot achieve the ideal treatment goals. Therefore, we further combined 3D printing technology with surface modification strategies to develop various 3D printing scaffolds with dual functions of tumor treatment and tissue regeneration, thereby more efficiently curing defects caused by tumor diseases. In addition, for the regeneration and construction of complex tissues/organs, it is necessary to develop biomimetic scaffolds with a regular arrangement of multiple cells. Therefore, we further extend 3D material printing to 3D multicellular printing, by regulating the composition of inorganic bioinks, designing cell spatial distribution, and constructing multicellular scaffolds that simulate different complex tissues. The multicellular scaffold constructed through 3D cell printing has excellent tissue regeneration function both in vivo and in vitro, which offers a foundation for the three-dimensional reconstruction of other complex tissues/organs.

Dr Chris Davis

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Biography

Chris obtained an honours degree and PhD in synthetic medicinal chemistry from Griffith University on the Gold Coast. For 2 years he worked in a biotechnology start-up company developing anti-bacterial drug candidates he co-invented during his PhD. Following the trade sale of that company he worked for commercialisation company, Uniquest Pty Ltd., in Brisbane, as commercial manager for the Biological and chemical sciences faculty at the University of Queensland. In 2009 Chris returned to Griffith University as General Manager of the Institute for Glycomics where he led a group of professionals dedicated to the strategic and operational development of the Institute, covering domestic and international business strategy, technology commercialisation, fund raising across the philanthropic, government, industry and private sectors, and general Institute operations. The primary focus of the Institute was translating its drug, vaccine and diagnostic discoveries into social and economic benefit, locally and globally.

In July 2024, Chris was appointed to the position of General Manager of the newly established Institute for Biomedicine and Glycomics. The Institute for Biomedicine and Glycomics brings together Griffith University's strengths in biomedicine through the merger of the Institute for Glycomics, Griffith Institute for Drug Discovery and biomedical elements of the Menzies Health Institute Queensland.

Chris serves as Chair of Ausbiotech Ltd Queensland Branch, Australia's biotechnology industry organisation.

Chris also serves as Deputy Chair, Regional Development Australia, Gold Coast.

Technology Development at the Institute for Biomedicine and Glycomics

The Institute for Biomedicine and Glycomics brings together Griffith's formidable strengths in biomedical research. By combining the outstanding discovery and translational research, infrastructure, and training expertise of the Griffith Institute for Drug Discovery, the Institute for Glycomics and biomedical teams from within the former Menzies Health Institute Queensland we will deliver real and immediate impacts locally and globally, transforming the lives of people around the world, especially those in disadvantaged communities.

The Institute has a rich history of drug, vaccine and vaccine technology development, taking Institute inventions from discovery through to human clinical trials. This presentation will explore the various ways the Institute has developed and commercialised its technologies through domestic and international industry engagement including in China, Europe and the US.

Professor Christian M Langton

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Biography

Christian Langton developed the technique of broadband ultrasonic attenuation (BUA) for osteoporosis assessment. He was awarded a DSc (University of Hull, UK) in 2007 and Honorary PhD (University of Eastern Finland) in 2015 for his extensive contributions to science, technology and clinical utility. His research has attracted over 7500 publication citations with a h-index of 43. Dr Langton currently serves as a Chief Investigator and Senior Research Fellow for an Australian NHMRC funded research project aimed at improving residual limb health for amputees, hosted by the Griffith Centre of Biomedical and Rehabilitation Engineering.

Top 10 Ultrasound Characterisation of Bone Innovations

1) Broadband ultrasonic attenuation (BUA) for assessment of osteoporotic fracture risk; 1984
2) World's first immersion commercial ultrasound bone analyser, UBA1001; 1986 US patent
3) Contact ultrasound bone analyser, McCue CubaClinical; 1993 US patent
4) Electronic Phantom, simulating ultrasound propagation through cancellous bone; 1996 US Patent
5) ZSD (standard deviation of Z-score): a universal parameter for measurement precision; 1997
6) *Langton Concept*, phase-cancellation is primary attenuation mechanism in cancellous bone; 2011
7) Ultrasound transit time spectroscopy for improved material characterisation and imaging; 2014
8) Combined transmission / pulse-echo ultrasound computed tomography system; 2017
9) 3D-printed ultrasound phase-interference compensator to reduce transcranial degradation; 2018
10) Dynamic Anatomical Ultrasonography to assess residual limb bone movement during motion; 2019

A 3D-Printed Phase-Interference Compensator to Improve Transcranial Ultrasound Imaging

Professor Christian M Langton
Griffith University

The human skull may be considered to consist of a sandwich of marrow-infused porous cancellous bone between two layers of essentially solid cortical bone. For an ultrasound wave propagating through the skull, anatomical variations in thickness and composition have the potential to create phase-interference and hence significant wave degradation, which may impede both diagnostic imaging and therapeutic interventions.

The conventional approach for diagnostic transcranial Doppler (TCD) ultrasound imaging of the brain is to utilise an '*acoustic window*' through the temporal bone of the skull; being relatively thin and uniform, it generally creates low levels of wave degradation. However, clinically useful data cannot be obtained in a significant number of subjects, increasing with age, and greater in females. For other anatomical regions of the skull, x-ray CT or MRI data may be utilised to implement an '*active*' time-reversal approach, adjusting the transmission delay of ultrasound pulses from a large array of individual transducer elements, typically 1000 in total. Although successfully reducing transcranial ultrasound wave degradation, it is inherently complex and requires a specialised ultrasound system.

The speaker has previously hypothesised that the primary mechanism for BUA (broadband ultrasonic attenuation) measurement in the cancellous bone of the human calcaneus is phase-interference, caused by a variation in transit time; as detected by the relatively large, single-element, phase-sensitive ultrasound receive transducer. He has also proposed a parallel sonic-ray concept for ultrasound propagation in cancellous bone; the transit time of each determined by the relative proportion of bone tissue and marrow, regardless of the complexity of structure. Hence, transit time minima and maxima correspond to propagation through entire bone tissue (t_{min}) and marrow (t_{max}) respectively. A transit time spectrum (TTS) describes the proportion $P(t_i)$ of sonic-rays having a particular transit time (t_i) between t_{min} and t_{max}. Reflection and refraction are considered to be secondary phenomena.

More recently, the speaker has proposed a '*passive*' means to reduce transcranial ultrasound wave degradation. The 3D-printed ultrasound phase-interference compensator (UPIC) consists of a twin-layer device to be positioned between the ultrasound transducer and subject's skin. The UPIC concept is fundamentally simple, it creates an environment of constant path-length (spatial criterion) and constant transit time (temporal criterion). Further, it could be implemented using a conventional ultrasound diagnostic imaging system.

Professor Chun-Xia Zhao

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Biography

Professor Chun-Xia Zhao is a Professor and an Australian National Health and Medical Research Council (NHMRC) Leadership Fellow in the School of Chemical Engineering at University of Adelaide, the Deputy Director of an Australian Research Council (ARC) Centre of Excellence, and an Honorary Professor at the Australian Institute for Bioengineering and Nanotechnology, The University of Queensland. She leads a research group focusing on bioinspired engineering, biomimetic nanomaterials and microfluidics for drug delivery and controlled release. She has been awarded three national prestigious fellowship (Australian Postdoctoral Fellowship 2011-2014 and ARC Future Fellowship 2015-2020, and NHMRC Leadership Fellowship 2022-2026). Her research in bio-inspired nanotechnology and microfluidics has attracted more than $55 M research funding as the chief investigator including ARC Centre of Excellence, Cooperative Research Centres Projects (CRC-P) Grant, MRFF grant, 8 ARC grants with 6 as the lead or sole investigator, NHMRC, AEA grant and many university and industry grants. Prof. Zhao has published 140 referred articles and book chapters in international top refereed journals such as Nature Nanotechnology, PNAS, Science Advances, Nature Comm, Angewandte Chemie International Edition, ACS Nano, Small, AM, AFM, and so on. She has been focusing on innovative research as evidenced by her seven patents. She has collaborated with many industry partners for translational research (Bioproton, BioCina, Cytiva, Vaxine, etc.) She has built extensive collaborations with scientists at top universities such as Harvard University, Brown University, etc. She serves as the Editors (Executive Editor of Chemical Engineering Science journal, etc.), Editorial Board member for several journals.

Influence of Virus-Mimetic Stiffness Modulation on Nanoparticle Cytosolic Delivery

Professor Chun-Xia Zhao

1. Australian National Health and Medical Research Council (NHMRC) Leadership Fellow, Deputy Director, Australian Research Council (ARC) Centre of Excellence; Professor at School of Chemical Engineering, University of Adelaide
2. Honorary Professor, Australian Institute for Bioengineering and Nanotechnology, University of Queensland.

Cytosolic delivery is essential yet remains a major challenge for efficient delivery of therapeutics including proteins and nucleic acids. Despite the clinical success of lipid nanoparticles, their delivery efficiency is limited, with only a small percentage (1-2%) escaping from the endosome. Through evolution, viruses have developed various mechanisms for effective endosomal escape. For instance, human immunodeficiency virus (HIV) dynamically adjusts their stiffness at different stages of their life cycles to enhance their infection ability. We discovered the crucial role of NP elasticity in modulating NP immune evasion and receptor-medicated cancer cell uptake using a nanoparticle library with a wide range of stiffness across four orders of magnitude (kPa to GPa). RNA sequencing analysis shows that soft and hard nanoparticles exhibit distinct cytosolic delivery efficiency through different signaling pathways. Our studies will provide new insights in designing novel nanoparticles for cytosolic delivery.

Dr Claudio Pizzolato

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Biography

Dr Claudio Pizzolato is a research leader within the Australian Centre of Precision Health and Technology (PRECISE), and a senior lecturer in the School of Health Science and Social Work, Griffith University. Claudio's research focuses on developing simulation of the human nervous, muscular, and skeletal systems and their interaction, with applications to neuro and musculoskeletal rehabilitation. Claudio co-leads the BioSpine Research project.

BioSpine: non-invasive multimodal rehabilitation for recovery of sensorimotor function after complete spinal cord injury

Spinal cord injury (SCI) disrupts communication between high brain centers and the peripheral neuromusculoskeletal system, resulting in debilitating sensorimotor impairment, autonomic dysfunction, and musculoskeletal degeneration. We developed a non-invasive multimodal rehabilitation system comprising a brain-computer interface (BCI), lower limbs functional electrical stimulation (FES) cycling, and virtual reality (VR) feedback. The system was controlled by a digital twin of the individual to enable the developed rehabilitation paradigm to elicit descending motor commands congruent with ascending sensory feedback. Four individuals with chronic complete SCI finished our year-1 study at Griffith University. While all participants gained discernible sensory, autonomic, muscular, and bone mineral density improvements, two of them additionally attained significant somatomotor benefits and recovered ability to voluntary contract previously paralysed muscles.

Associate Professor Dai Fei Elmer Ker

Associate Professor

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Biography

Dai Fei Elmer Ker is an Associate Professor in the Department of Biomedical Engineering at The Hong Kong Polytechnic University. He completed his B.S. in Molecular Biology and Genetics at the University of Sydney, Ph.D. in Biological Sciences at Carnegie Mellon University, and postdoctoral training in the Department of Orthopaedic Surgery at Stanford University. His research interests include biomaterial development and computer vision-based cell tracking. His work has been published in prestigious journals such as Advanced Materials, Advanced Functional Materials, Acta Biomaterialia, Bioactive Materials, Biomaterials, Medical Image Analysis, NPG Asia Materials, Scientific Data, Stem Cell Research & Therapy, and Science.

Education and Academic Qualifications

- University of Sydney, BSc (Molecular Biology & Genetics) First Class Honours
- Carnegie Mellon University, Ph.D. (Biological Sciences)
- Stanford University, Postdoctoral trainee (Orthopaedic Surgery)

Academic and Professional Experience

- Associate Professor, Department of Biomedical Engineering, The Hong Kong Polytechnic University, 2024 - present
- Assistant Professor, Institute for Tissue Engineering and Regenerative Medicine, School of Biomedical Sciences, The Chinese University of Hong Kong, 2017 - 2024
- Infantry Officer, 30th Singapore Infantry Brigade, Singapore Armed Forces, 2004 - 2006

Research Interests

Musculoskeletal Tissue Engineering / Artificial Intelligence / Biomaterials / Computer Vision / Microscopy

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Rapid and Facile 3D-printing of Mechanically Robust and Bioactive Grafts for Challenging Rotator Cuff Tendon Injuries

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Cost-effective treatment of severe tendon injuries requires mechanically tendon-like and bioactive grafts that can be easily manufactured and personalized for patient use. However, a key challenge remains in the rapid and facile production of biomaterial grafts with tough and pro-regenerative attributes to address mechanical and biological deficits present in large-to-massive rotator cuff tears. In this study, we have developed a 3D-printable polythiourethane (PHT polymer) that can be rapidly and easily prepared with 30 min mixing at room temperature under ambient conditions followed by visible light photocrosslinking and heat curing. Mechanically, 3D-printed PHT polymer exhibited strong and robust physical attributes including the ability to sustain 10,000 cycles of physiologic loading (0.2-3 MPa per cycle) without failure as well as maintain tendon-like tensile attributes due to its slow degradation. Biologically, 3D-printed PHT polymer was biocompatible and incorporation of tendon-promoting fibroblast growth factor-2 (FGF-2) and transforming growth factor-β3 (TGF-β3) promoted tendon-like differentiation in vitro. In a large-to-massive rabbit rotator cuff tendon injury model, 3D-printed PHT polymer containing FGF-2 and TGF-β3 resulted in similar biomechanical attributes as uninjured contralateral shoulder and regenerated at least 1-cm of tendon tissue following 8-weeks implantation (**Figure 1**). Altogether, this work demonstrates rapid and facile production of 3D-printable materials with native tissue-like mechanical attributes and pro-regenerative bioactivity for treating large-to-massive rotator cuff tears.

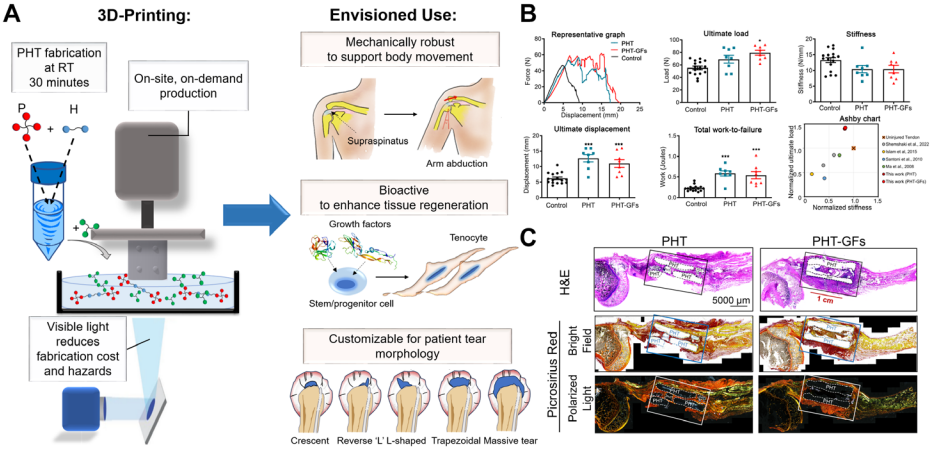

Figure 1 Rapid, facile production of strong and bioactive 3D-printable PHT graft. (A) Concept for fabrication and use of 3D-printable, PHT polymer. **(B)** PHT polymer exhibited tendon-like attributes including restoration of uninjured shoulder biomechanical attributes. **(C)** PHT polymer with bioactive cues showed enhanced regeneration at least 1-cm of neotendon formation in vivo.

Professor Dong-An Wang

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Biography

Dr. Dong-An Wang is a Professor of Department of Biomedical Engineering in City University of Hong Kong. Dr. Wang has authored nearly 200 research and scholarly publications and numerous patents. The publications include those published in Nat Mater, Adv Mater, etc., some of which are editorially quoted by Science, Nat Mater, etc. Dr. Wang has been conferred with Best Paper Award by Elsevier and Euro Federation for Pharm Sci, and Biomaterials Science Prize by Royal Society of Chemistry. Dr. Wang is a Fellow of Royal Society of Chemistry. Dr. Wang is ranked as the Top 2% of the World's Most Highly Cited Scientists by Stanford University. Dr. Wang is a member of Biology & Medicine Panel, Research Grants Council (RGC), Hong Kong. Dr. Wang used to be Assoc Chair of School of Chemical and Biomedical Engineering, Nanyang Technological University Singapore; Acting Head of Department of Biomedical Engineering, City University of Hong Kong; and, Head of Research at Karolinska Institutet Ming Wai Lau Centre for Reparative Medicine. Dr. Wang is currently a Foreign Adjunct Professor at Department of Neuroscience, Karolinska Institutet.

Decellularized Tissue Engineering Hyaline Cartilage Graft for Articular Cartilage Repair and Its Forward-Looking Test for Space Medicine

Articular hyaline cartilage, a tissue articulating skeleton at joints, is highly prone to damages caused by trauma, diseases and ageing; once injured, its self-regeneration is difficult and slow due to the avascular nature. To repair and regenerate damaged articular cartilage, we have innovatively developed a continuous methodology to directly set up a macro-scaled 3D decellularized tissue engineering hyaline cartilage graft (dLhCG). Good osteochondral defect healing and complete integration with adjacent native cartilage in in-situ implantation of dLhCG samples in large animal models demonstrated the competence of dLhCG as a cartilage graft. Investigative clinical trials have been initiated in China and the initial curative effect appears positive. Based on this, for the coming of the Space Age, a forward-looking space experiment is designed and performed with dLhCG for future space medicine. For this purpose, dLhCG samples have been delivered onto Chinese Space Station via Tianzhou-6 cargo spacecraft for a six-month space experiment.

Haiyan Li

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Biography

Dr. Haiyan Li is currently a senior lecture in Biomedical Engineering department, School of Engineering, RMIT University. She received a PhD degree in Materials Science and Engineering in 2005 from Shanghai Institute of Ceramics, Chinese Academy of Science and has performed research work in Biomaterials and Tissue Engineering field for about 20 years. She completed two postdoctoral research fellows in Monash University (Australia) and INSERM (France) before she joined in Shanghai Jiao Tong University (China) in 2011. She had then worked in SJTU for about 10 years, contributing to research and teaching in biomaterials and tissue engineering and been a tenured associated professor before she joined in RMIT in January of 2021.

Dr. Li has a strong research track record in biomaterials and tissue engineering and has published to over 120 peer-reviewed publications, 8 patents (5 has been granted), leading to a total citation around 8100 and a research H-index of 50. She is also a chief investigator of 11 major fundings, including 4 from the National Natural Science Foundation of China and 1 from CASS foundation (Australia).

Dr Li's current research interests are bioactive hydrogels and microgels for cancer therapy, tissue regeneration and 3D printing.

Granular Microporous Hydrogels for Promoting Tissue Regeneration

Haiyan Li

RMIT University

Hydrogels have proven useful in regenerative medicine. However, conventional hydrogels inherently have nanoporous structure, which limit mass transport of key biomolecules and restrict the behaviour of cells and infiltration of surrounding tissue and cells. Granular hydrogels show great promise in tackling the problems of the conventional nanoporous hydrogels. Additionally, to closely recapitulate the inherent healing cascades, sequential delivery strategies are urgently need for enhancing various kinds of tissue regeneration.

We have developed a serial of novel granular injectable microporous hydrogels for promoting diabetic wound healing, articular cartilage regeneration and tendon-to-bone Healing. The hydrogels were designed and fabricated with widely used biomaterials, such as sodium alginate (SA), methacrylated hyaluronic acid (MeHA), and additional bioactive ingredients, such as Bioglass (BG), small extracellular vesicles (sEVs) or kartogenin (KGN) for stimulating different stages of wound healing or tissue regeneration.

For example, a bioactive macroporous self-healable hydrogel by assembling methacrylated hyaluronic acid (MeHA) and 3-aminophenylboronic acid modified sodium alginate (SABA) microgels with BG. The obtained microporous hydrogels have larger pore size than nanoporous hydrogels, which facilitated cell infiltration, viability and proliferation. Meanwhile, the macroporous hydrogels had good self-healing abilities with the formation of dynamic B-O bonds. Furthermore, with the bioactivity of BG, the hydrogels could induce cell migration and ingrowth of cells and blood vessels.

Additionally, a novel granular hydrogel was developed for articular cartilage regeneration. In this study, SA) and MeHA (SA/HA) microfibers (μ-fibers) were fabricated by wet-spinning technology and assembled into microporous hydrogels. sEVs derived from NR8383 cells activated by lipopolysaccharides (LPS) and stimulated with BG ion extracts (LPS/BG-exo) were released from the hydrogel to adjust inflammation homeostasis and recruit BMMSCs. Meanwhile, poly (lactic-co-glycolic acid) (PLGA) microspheres containing kartogenin (KGN) ($PLGA_{KGN}$) were encapsulated within the hydrogel for inducing the chondrogenic differentiation of recruited BMMSCs when KGN is released after the LPS/BG-exo. The obtained macro-porous SA/HAexo-$PLGA_{KGN}$ hydrogel can enhance the cartilage regeneration in a rat cartilage defect model.

Furthermore, a novel macroporous hydrogel comprising sodium alginate/hyaluronic acid/small extracellular vesicles from adipose-derived stem cells (sEVs) (MHA-sEVs) with aligned architecture and immunomodulatory ability was also developed for osteoporotic tendon-to-bone healing.

To directly incorporate BG particles into the microgels, we established a method to fabricate fiber-like microgels containing BG particles via mechanical fragmental and wet-spinning method, addressing the potential needle blocking issue during wet-spinning and introducing bioactivities of BG into the microporous injectable hydrogels. This hydrogel was used to adjust inflammation of diabetic wounds and enhance angiogenesis during diabetic wound healing, showing great application in diabetic wound healing.

In conclusion, we have established several methods to fabricate granular injectable hydrogels to address the limitations of existing nanoporous injectable hydrogels and our studies show that these hydrogels can enhance cell viability, facilitate cell migration and infiltration, modulate wound inflammation, improve implant-host integration, and have great applications in tissue regeneration.

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Biography

Hala Zreiqat, is a Payne-Scott Professor of biomedical engineering at The University of Sydney. The focus of her lab is on engineering functional synthetic biomaterials for use in regenerative medicine using cutting-edge materials, biological and nano techniques, and novel 3D-printing technologies.

Prof. Zreiqat's contribution to regenerative medicine and orthopaedic research has led to a number of national and international awards, including being named a Member of the Order of Australia (2019), 2021-2022 Fulbright Senior Scholar; Laureate TAKREEM Foundation 2022 "Scientific & Technological Achievement"; 2021 Finalist AmCham Alliance Award (Biotechnology); the 2018 New South Wales Premier's Woman of the Year, the King Abdullah II Order of Distinction of the Second Class (2018), Harvard Radcliffe Fellow, Harvard University (2016-2017); Eureka Prize winner for Innovative Use of Technology (2019); and University of Sydney Payne-Scott Professorial Distinction (2019). She is also a Fellow of the Australian Academy of Sciences (2021); the Australian Academy of Technology & Engineering (2020), the International Association of Advanced Materials (2022), the Royal Society of New South Wales (2019); Australian Academy of Health and Medical Sciences (2019), and the International Orthopaedic Research Society (2019). She is the past president of the Australian & New Zealand Orthopaedic Research Society. Director of the Australian Research Council Training Centre for Innovative BioEngineering (2017-2022) and a National Health and Medical Research Council Senior Research Fellow (2006-2020). She is currently serving as the chair of the Australia-Arab Council, having held the position for two terms (2020 to 2023, and 2024 to 2026). She an Associate of the John A. Paulson School of Engineering and Applied Sciences at Harvard University and an Honorary Professor at Shanghai Jiao Tong University.

Prof. Zreiqat has authored over 180 peer-reviewed publications and her research in the field of musculoskeletal disorders and biomaterials has led to four awarded and four provisional patents and more than $20.5M in competitive funding, including major grants from the National Health and Medical Research Council, Australian Research Council and the New South Wales Medical Devices Fund.

As well as her pioneering work in biomaterials development, Prof. Zreiqat is committed to improving opportunities for women and young scientists around the world. She is the founder and Chair of the BIOTech Futures, a science and engineering mentorship program for high school students.

Innovations in Nanostructured 3D-Printed Bioceramics for Personalized Bone Healing

Hala Zreiqat
Biomaterials and Tissue Engineering Unit, University of Sydney, Sydney Australia

The growing clinical need for synthetics that specifically enhance the repair of critical driven largely by an ageing population whose natural regenerative responses are impaired. This presentation will describe the following: 1) our strategies in developing a platform of patented engineered nanostructured, 3D-printed biomaterials for cell-free personalised treatment to promoting bone healing in load bearing challenging situations. 2) our unique fabrication strategies that will enable customisation of the implant's shape, size, structure and architecture to meet patient-specific requirements (Fig 1 &2), 3) Identification of the composition of bioceramics that achieves antibacterial effects. Our technologies open avenues for skeletal and soft tissue regeneration in various clinical applications.

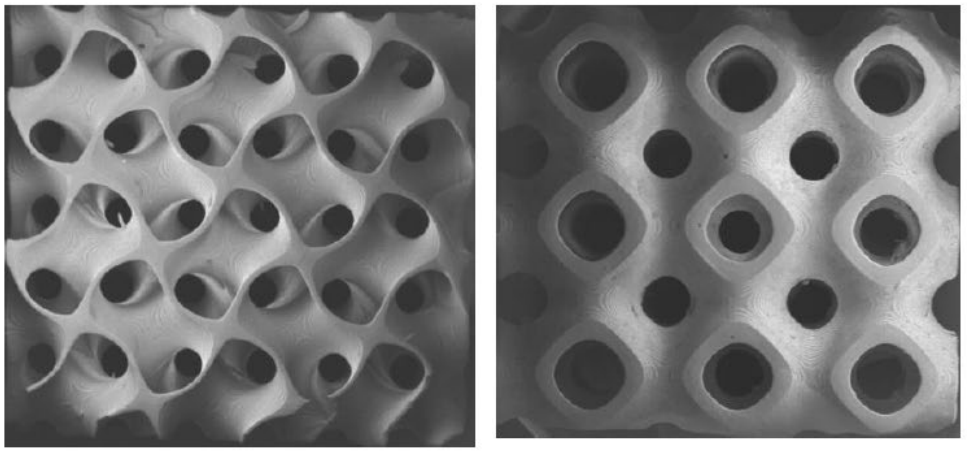

Figure 1: SEM micrographs displaying the structure of 3D models and sintered ceramic scaffolds, scale bar = 1 mm.

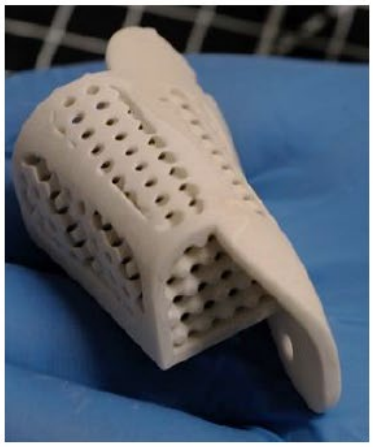

Fig 2: 3 D printed full ceramic mandible scaffold (6 cm)

Professor Han Huang

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Biography

Professor Han Huang is a Chair Professor at School of Advanced Manufacturing, Sun Yat-sen University, China, and an Emeritus Professor of Mechanical Engineering at The University of Queensland, Australia. He has been leading a group of researchers to develop advanced manufacturing technologies, particularly ductile grinding processes for brittle solids, in the past decades. Professor Huang obtained his PhD at The University of Western Australia and ME and BE at Huazhong University of Science and Technology, China. He has published over 320 peer-reviewed journal articles with a total citation of over 11,600 times, giving him an h-index of 59. He received a number of research accolades including Australia Research Council Future Fellow, Australian Research Fellow,Queensland International Fellow, JSPS Invitation Senior Fellow, and Singapore National Technology Award. Professor Huang is an Associate Editor of International Journal of Mechanical Sciences and International Journal of Extreme Manufacturing.

Brittle–ductile threshold in lithium disilicate under sharp sliding contact

Professor Han Huang
School of Advanced Manufacturing, Sun Yat-sen University, China

Computer-aided manufacturing and handpiece grinding are critical procedures in the fabrication and adjustment of ceramic dental restorations. However, due to the formation of microfractures, these procedures are detrimental to the strength of ceramics. This study analyses the damage associated with current brittle-regime grinding and presents a potential remedy in the application of a safer yet still efficient grinding regime known as “ductile-regime grinding.” Single-particle micro-scratch tests were conducted on the disc-shaped specimens of a lithium disilicate glass-ceramic material. Key parameters such as coefficient of friction and penetration depth were recorded as a function of scratch load. Further, biaxial flexure strength tests were performed to analyse their effects on ceramic strength. Statistical analysis was performed using one-way analysis of variance and Tukey tests. While SEM surface analysis of scratch tracks revealed the occurrence of both ductile and brittle removal modes, the threshold load for brittle–ductile transition was determined based on FIB subsurface damage analyses in conjunction with strength degradation studies. In the ductile regime of grinding, the specimens exhibited neither strength degradation nor the formation of subsurface cracks. Determination of the brittle–ductile thresholds is significant because it sets a foundation for future research on the feasibility of implementing ductile-regime milling/grinding protocols for fabricating damage-free ceramic dental restorations.

Professor Hang Ta

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Biography

Hang Ta is a Professor at School of Environment and Science and Queensland Micro- and Nanotechnology Centre, Griffith University. She is a Heart Foundation Future Leader Fellow and currently leads a team of 12 students and postdocs working on materials for diagnosis and treatment of life-threatening diseases. She has a unique skill set combining chemistry and biology skills. She got a PhD in biomaterials for drug delivery from University of Melbourne and then worked at Baker Heart and Diabetes Institute and University of Queensland before moving to Griffith University in 2020. Prof Ta has been awarded a number of prizes, grants and prestigious fellowships such as National Heart Foundation postdoctoral fellowship, NHMRC ECR fellowship and Heart Foundation Future Leader Fellowship. She is President of the Australian Society for Molecular and Imaging, Associate Editor of Artificial Cells, Nanomedicine and Biotechnology, is on Editorial Boards and is a peer reviewer for several journals, is a chair/co-chair of international and national conferences. She is a member of ARC College of Expert, serves on the committees of various scientific societies and also serves on different national grant review panels (e.g. ARC, NHMRC, MRFF).

Novel Microfluidics Models of Atherosclerosis and Atherothrombosis

Fahima Akther,[1,2] Dimple Thomas,[1,3] Huong D.N. Tran,[1,2] Shebbrin Moonshi,[1] Yuao Wu,[1] Jun Zhang,[1] Nam-Trung Nguyen,[1,3] Hang T. Ta,[1,2,3*]

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Atherosclerosis is an inflammatory disorder of blood vessels that is a major cause of death worldwide. Atherothrombosis, an atherosclerotic plaque disruption condition with superimposed thrombosis, is the underlining cause of cardiovascular episodes. Monocyte recruitment and transmigration are crucial in atherosclerotic plaque development. The multi-disease complexities aggravate the situation and continue to be a constant concern for understanding atherosclerosis plaque development. We have developed 3D models mimicking the development of atherosclerosis and thrombosis under static condition in 96-well plate[1] and also under flow condition in microfluidic devices[2,3]. We have demonstrated that these models could be employed to study disease development, to test efficacy of drugs and nanomedicine, and to evaluate thrombosis risk and treatment strategies.

References

[1] F. Akther, D. Sajin, S. S. Moonshi, Y. Wu, K. Vazquez-Prada, H. T. Ta. Advanced Biology, 8 (**2024**), 2300463.
[2] F. Akther, J. Zhang, H. D.N. Tran, H. Fallahi, H. Adelnia, H.P. Phan, N.T. Nguyen, H. T. Ta. Advanced Biology, 6 (**2022**), 2101316.
[3] F. Akther, H. Fallahi, J. Zhang, N.T. Nguyen, H. T. Ta*. Lab on a Chip, 24 (**2024**), 2927-2943.

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Biography

Dr Hongxu Lu is now working at the Shanghai Institute of Ceramics, Chinese Academy of Sciences (SICCAS), leading the Organoid Biomaterials and Devices Group.

Hongxu Lu obtained his BSc and MSc degrees in Biology from the Ocean University of China, and his PhD in Materials Science and Engineering from the University of Tsukuba, Japan, in 2009. Then he worked as a postdoc researcher at the National Institute for Materials Science of Japan under the supervision of Prof. Guoping Chen. In 2012, he joined Prof. Martina Stenzel's group at the University of New South Wales as a research associate. From 2015 to 2018, he worked as an ARC DECRA research fellow at the School of Chemistry UNSW. Before joining SICCAS, he worked with Prof Dayong Jin at the Institute of Biomedical Materials and Devices at the University of Technology Sydney.

Dr Lu's research focuses on the development of 3D in vitro cellular models, such as organoids, spheroids and tissue engineered constructs, combining 3D cell culture, stem cell biology, biomaterials, and microfluidic technologies, for biomedical applications. Up to now, Dr Lu has published more than 100 peer-review journal papers, including Advanced Science, Biomaterials, Biofabrication, Lab on a chip, Acta Biomaterialia, etc. He was awarded the Young Scientist Award from the International Symposium of Materials on Regenerative Medicine in Taiwan in 2010 and the Young Investigator Award from the Japanese Society for Regenerative Medicine in 2012.

Development of Bioactive Materials for Organoid Culture

Organoids have structures and functions that are similar to corresponding tissues/organs in the body. They have become a promising in vitro model for drug screening and personalized medicine. In addition, organoids maintain a high level of potential for the growth and differentiation of stem cells, providing a promising cell source for tissue engineering and regenerative medicine. The growth and development of organoids require hydrogel support, with Matrigel currently being the main hydrogel used for organoid culture. However, matrix gels derived from mouse EHS tumors have complex compositions, poor mechanical properties, and significant differences between batches. Matrix gels are not conducive to physical or biochemical manipulation, making it difficult to promote the desired cell behavior and specific biological effects through fine-tuning of matrix properties. Finding new biomaterials to replace ECM hydrogels, such as Matrigel is one of the hot topics in organoid research. In this study, we have been developing several types of bioactive materials, such as alginate hydrogel and inorganic-organic composite bioinks, for organoid culture. Through the addition of ECM components or inorganic active ions, stem cell differentiation can be induced to form organoids. By adjusting the mechanical strength of the materials and combining them with microfluidic chip technology for dynamic culture, the growth and development of stem cells can be controlled. This study also investigates the effects and biological mechanisms of materials and microenvironments on the growth and development of organoids.

Keywords: organoids culture, hydrogel, biomaterials, microfluidics

Professor James St John

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Biography

Professor James St John is Head of the Clem Jones Centre for Neurobiology and Stem Cell Research at Griffith University. James is a translational neuroscientist specialising in the creation and delivery of therapies to repair injuries and diseases of the nervous system.

The major project of the Centre is the translation of a cell transplantation therapy to repair spinal cord injury. This community co-designed therapy is now progressing to a clinical trial that will commence in late 2024 in Queensland, Australia.

The therapy uses transplantation of olfactory glial cells within three-dimensional cellular nerve bridges to repair the injury site of chronic spinal cord injury. When combined with intensive, long-term rehabilitation it is anticipated that the therapy will commence the restoration of motor, sensory and autonomic function. The trial is designed to identify the types of chronic spinal cord injuries that respond to the treatment.

Since the commencement of the Centre, Prof St John has been lead investigator on more than $40 million of research projects funded by philanthropy, state and federal government including NHMRC and MRFF funding.

James was awarded the 2019 NHMRC Marshall and Warren Innovation Award for the potentially transformative power of the olfactory nerve bridges.

Autologous Olfactory Ensheathing Cell Nerve Bridge Transplantation and Intensive Rehabilitation for Repairing Chronic Spinal Cord Injury

The Spinal Injury Project at Griffith University is conducting a world-first Phase I blinded and randomised control trial to test a cell transplantation and rehabilitation therapy for repairing acquired spinal cord injury.

The therapy uses olfactory ensheathing cells (OECs) obtained from autologous intranasal biopsies of the olfactory mucosa. The therapeutic strength of OECs is based on their multiple mechanisms for stimulating neural repair including cleaning up of cell debris, creation of a permissive surface for axon growth, secretion of growth factors, and ensheathment and maintenance of axons. Using an innovative technology, OECs are formulated into stable bridge-like structures which are surgically placed into the injury site. This permissive bridge then promotes neural repair which is reinforced with rehabilitation.

We have completed two precursor clinical trials which have confirmed the safety, feasibility and acceptability of the intensive long-term rehabilitation program. Thirty participants (18+ years) are being recruited who have chronic acquired spinal cord injury (C5-T12) and >4 months post-injury with complete or incomplete loss of motor, sensory and/or autonomic function (AIS A, B, low functioning AIS C).

The trial is being conducted at the Gold Coast University Hospital, with transplantation surgery performed at the hospital. Before and after the transplantation surgery, participants will undergo intensive long-term rehabilitation at specialist providers on the Gold Coast, Sydney or Melbourne.

The trial has been co-designed with consumers, clinicians and industry partners and builds on our extensive proof-of-concept preclinical data which demonstrate efficacy for restoring motor, sensory and autonomic function.

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Biography

Dr Jiao Jiao Li FRSN FRSB is a Senior Lecturer in Biomedical Engineering at University of Technology Sydney. Her research in regenerative medicine focuses on developing combinational approaches including stem cells and bioactive materials to treat chronic diseases, particularly bone and joint disorders. She was a National Health and Medical Research Council (NHMRC) Early Career Fellow, Endeavour Research Fellow, Co-Deputy Director of the Australian Research Council Training Centre for Innovative BioEngineering, and a Science & Technology Australia 2021-22 Superstar of STEM. She is a Board Director and Chair of the Equity, Diversity and Inclusion (EDI) Committee for Science & Technology Australia, as well as a Board Director of Australian Institute of Policy & Science (AIPS). Her research has been recognised by numerous awards, recently the Young Investigator Award from Tissue Engineering & Regenerative Medicine International Society (TERMIS), Eureka Prize for Emerging Leader in Science, Metcalf Prize for Stem Cell Research, Premier's Prize for NSW Early Career Researcher of the Year (Physical Sciences), and NSW Young Tall Poppy Scientist of the Year.

Stem cell-based therapies for treating osteoarthritis

Osteoarthritis (OA) is a leading cause of disability affecting 600 million people worldwide. Characterised by joint-wide inflammation and structural damage, OA causes chronic pain and significantly impairs the patient's ability to perform daily activities. Despite having huge socioeconomic consequences, OA has no cure.

Currently, all available treatments for OA focus on relieving pain, with little effect on slowing disease progression. Driven by the urgent need for a new solution, stem cell therapies have recently emerged, among which mesenchymal stem cells (MSCs) have been the most commonly tested due to their natural anti-inflammatory and restorative functions [1]. However, despite positive results obtained in preclinical studies, existing clinical trials using MSC injections to treat knee OA have not demonstrated consistent benefits [2].

The efficacy of MSC therapy for clinical OA treatment is limited by some key factors: (1) variation in the characteristics of MSCs derived from different tissue sources, (2) inevitable loss or death of a majority of cells after injection, (3) suboptimal function of cells grown using traditional 2D culture methods. Our team has investigated strategies to address each of these challenges, by (1) experimenting with more pluripotent sources of MSCs (e.g., derived from umbilical cord), (2) using microcarrier systems to enable more efficient delivery into the joint and greater cell viability after injection, (3) optimising 3D culture methods to enhance MSC paracrine activity.

Interestingly, our recent work also demonstrated that live MSCs may adopt the diseased characteristics of the OA joint after injection, hence reducing their long-term therapeutic benefits [3]. This has prompted us to look into harnessing the MSC secretome to generate cell-derived bio-therapeutics as a new-generation treatment option for OA. We hope that our combined therapeutic discovery strategy can in the future be adapted for other types of chronic diseases.

References:

[1] G. Wang, D. Xing, W. Liu, Y. Zhu, H. Liu, L. Yan, K. Fan, P. Liu, B. Yu, J. J. Li, B. Wang, *International Journal of Rheumatic Diseases*, 2022, 25: 532-562.

[2] Z. Shang, P. Wanyan, B. Zhang, M. Wang, X. Wang, *Stem Cell Research & Therapy*, 2023, 14: 91.

[3] V. Shang, J. Li, C. B. Little, J. J. Li, *European Cells & Materials*, 2023, 45: 143-157.

Dr Karan Gulati

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Biography

Dr Karan Gulati is a Research Group Leader and the Deputy Director of Research at the School of Dentistry, The University of Queensland (UQ). He is also the Deputy Director of the Centre for Orofacial Regeneration, Reconstruction and Rehabilitation (COR3) at UQ Dentistry.

Dr Gulati is a pioneer in electrochemically nano-engineered dental implants with over 14 years of extensive research experience using nano-engineering towards various bioactive and therapeutic applications. Dr Gulati completed his PhD from the University of Adelaide (Australia) in 2015 and was awarded the Dean's Commendation for Doctoral Thesis Excellence. His career has been supported by prestigious fellowships from NHMRC (National Health and Medical Research Council, Australia), JSPS (Japan Society for the Promotion of Science, Japan), Erasmus+ (Germany) and the University of Queensland. At 8 years post-PhD, Dr Gulati has edited 3 books, published 7 chapters and >72 publications (h-index 38), and presented >115 times in various reputed conferences.

Dr. Gulati's research group, GATORs (Group for Anodized Therapies for Osseointegration, Regeneration and Stimulation), focuses on the developments and challenges associated with nano-engineered implants, focusing on generating tailorable devices that can address the unique challenges related to biomedical implants.

Nano-Engineered Dental Implants: Topography, Therapy & Trigger

Enhancing integration, achieving immunomodulation and preventing infection at the interface between dental implants and tissue is crucial for ensuring implants' long-term success, especially in compromised patient conditions. Nano-engineering strategies, like electrochemical anodisation (EA), are promising methods for modifying dental implant surfaces, improving integration and reducing infection risks. This research presents novel dental implant surfaces that have been nano-engineered to deliver augmented integration (at bone and soft-tissue level), immunomodulation and bactericidal functions via a combined trio of topography, therapy and trigger. Dental implants are modified via EA to fabricate controlled nanotopography (pores, tubes, pillars), followed by in-depth surface topography, chemistry and stability characterisation. Next, in separate settings, loading of drugs and electrical stimulation therapy (EST, application of small pulses of voltage) is enabled towards local therapy and trigger. Further, primary osteoblasts, fibroblasts, macrophages and human oral salivary biofilm are cultured onto the modified implants. The investigation reveals that topography promotes osteogenesis, soft-tissue sealing and tissue-reparative M2 phenotype macrophage polarisation. The fabrication of bioinspired 'bed of nails' nanostructures, local elution of Gallium and EST confirm superior antibacterial abilities. Anodised implants that can tailor topography, therapy, and trigger present significant promise in delivering patient-specific implant solutions with reduced complications.

Professor Kelvin Yeung

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Biography

Professor Kelvin Yeung is a distinguished scholar in orthopedic biomaterial research, focusing on the design of orthopedic biomaterials, antibacterial nanomaterials, 3D bioprinting, and musculoskeletal tissue engineering. He holds a bachelor's degree in materials science, and both a master's degree and PhD in orthopedic science from the LKS Faculty of Medicine, The University of Hong Kong (HKUMed). His research is dedicated to bone-to-implant osseointegration, bone regeneration, and the development of antibacterial treatments.

Currently, Professor Yeung holds the **Ng Chun-Man Professorship in Orthopaedic Bioengineering** and serves as a tenured full professor, chief of the research division, and departmental research and postgraduate advisor within the Department of Orthopaedics and Traumatology at the School of Clinical Medicine, HKUMed, The University of Hong Kong. He also holds honorary appointment at the Zhongshan Hospital of Fudan University. Widely recognized for his scholarly impact, he is listed among the Highly Cited Researchers (cross-field), Highly Ranked Scholar in Medicine by ScholarGPS (Global ranking: #7 in Biomaterial; #16 in Orthopaedic Surgery), and ranks among the Top 1% of scholars worldwide in biomaterials by Clarivate Analytics' Essential Science Indicators (ESI). He has been listed among the World's Top 2% Scientists in Biomedical Engineering since 2014 and was ranked #1845 globally and #483 in China in materials science by Research.com in 2024.

Professor Yeung has an extensive publication record with over 300 peer-reviewed SCI journal articles and 46 filed patents. Throughout his career, he has secured over HK$92 million in research funding. A strong advocate for diversity, equity, and inclusion, he has trained many researchers, over 50% of whom are female, African, or Middle-Eastern. He has received more than 30 awards and delivered over 90 invited talks at prestigious conferences.

In addition to his research and teaching, Professor Yeung has held several executive positions. He is the Associate Editor of Bioactive Materials Journal, the current President and founding member of the Chinese Association for Biomaterials (CAB), Chair of Orthopaedic Biomaterials for the Society for Biomaterials (SFB) USA, and has served as past Secretary and Treasurer of CAB and past Vice-Chair of SFB Orthopaedic Biomaterials. He is also the Associate Dean of Student Affairs for the HKU Centre of Development and Resources for Students (CEDARS) and Warden of Simon K. Y. Lee Hall, overseeing student education development.

2024 International Conference for MedTech & Regenerative Medicine and Dentistry

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Enhancing Bone-to-Implant Osseointegration via Photocurrent-Driven Immunoregulation and Calcium Influx Activation in Macrophages

Kelvin Yeung
Faculty of Medicine, The University of Hong Kong (HKUMed)

Introduction/Objectives: The foreign body reaction is a natural response to an implant, involving complex cellular and molecular events that determine implant integration. Macrophages, among the first immune cells to arrive, initiate acute inflammation, recruit mesenchymal stem cells (MSCs), and start regeneration. This proinflammatory response peaks within 24-48 hours post-implantation. If immune self-regulation is compromised, uncontrolled inflammation can become chronic, leading to implant failure. Implant loosening accounts for over 10% of failures. Thus, promptly restoring the osteoimmune microenvironment after initial inflammation is crucial to prevent chronic inflammation and ensure successful osseointegration.

Methods: Hydroxyapatite, a widely used biocompatible orthopedic biomaterial, was utilized to fabricate an excitable surface via laser cladding on titanium substrates. The high-temperature cladding process facilitated the decomposition of HA and its subsequent interaction with the Ti substrate. A comprehensive surface characterization was conducted using X-ray diffraction, X-ray photoelectron spectroscopy, and electron spin resonance spectroscopy to investigate the properties of the excitable surface. The photocatalytic activity of this surface under 808 nm near-infrared (NIR) irradiation, along with the underlying mechanisms, was examined using electrochemical measurements and hybrid density functional theory calculations. The impact of the photocurrent generated by the excitable surface under NIR light on the modulation of the osteoimmune microenvironment was evaluated through both in vitro and in vivo studies to assess its effectiveness in promoting osseointegration.

Results: A defective engineered n-n heterojunction between $CaTiO_3$ and TiO_2-Vo ($CaTiO_3$-TiO_2-Vo) was formed on the excitable surface. Under NIR light irradiation, this surface generated a photocurrent that accurately directed macrophage polarization, thereby alleviating acute inflammation in the early post-implantation phase. Transcriptomic analysis and in vitro studies indicated that photoelectric signals initiated an increased calcium influx in macrophages under NIR irradiation, which altered the expression of calcium/calmodulin-dependent protein kinase kinase 2 and calcium/calmodulin-dependent protein kinase I to inhibit M1 macrophage polarization. This resulted in a favorable osteoimmune microenvironment that enhanced the recruitment of MSCs and osteogenesis, thereby accelerating osseointegration within 14 days following implantation.

Conclusions: In summary, we designed an excitable surface capable of remotely manipulating the osteoimmune microenvironment to facilitate osseointegration. Upon NIR irradiation, the excitable surface generated an intensified photocurrent, which activated voltage-gated calcium channels to instruct macrophage phenotype switching on the implant surface, favoring M2 macrophage dominance. The cytokine profile included reduced pro-inflammatory cytokines (TNF-α and iNOS) and increased anti-inflammatory cytokines (ARG-1 and IL-10). This favorably modulated osteoimmune microenvironment significantly accelerated osseointegration in a tibia defect in an in vivo animal model as early as 14 days post-implantation.

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Biography

Professor Vasilev is currently a Matthew Flinders Professor and a Professor of Biomedical Nanotechnology in the College of Medicine and Public Health at Flinders University. Prior to taking a position at Flinders University, Professor Vasilev had built and led at The University of South Australia (UniSA) a large and highly productive team, which grew to more than 20 postdocs and PhD students. His team is well connected having deep collaborative networks within Australia and internationally, and is strongly engaged with industry, end users, government agencies and community. Professor Vasilev has attracted in excess of 25M dollars in research funding from Government competitive grants and Industry, published more than 320 papers and has been awarded several prestigious Research Fellowships from ARC, NHMRC and the Humboldt Foundation, and other awards such as the John A. Brodie Medal for achievements in Chemical Engineering in 2016, and the election of a Fellow of the Royal Society of Chemistry (FRSC) in 2017 and a Fellow of the International Association of Advanced Materials in 2022. His contribution to UniSA has been recognised by several awards including the UniSA Research Excellence Award in the Mid-Career category (2018), and the Division of ITEE Excellence Award for Leadership in Research (2018), and the UniSA Interdisciplinary Award (2019) for his work across disciplines.

Professor Vasilev has established international reputation and leadership in his field evident (in addition to the awards mentioned above) by regular invitations to deliver plenary and keynote lectures at international conferences, and prestigious universities, institutes and companies around the world. The foundation of his research program was his revolutionary approach to the nanoengineering of plasma polymer films, which vastly expanded the opportunities for this technology. His publications have been cited more than 13700 times and his H-index = 65 (M-index ~ 3).

Professor Vasilev's research has a very strong translational focus. He has a track record of working with commercial partners to industrialize biomedical technologies. These include leading large commercial projects such as a $5M CRC-P project together with Motherson Australia Pty Ltd on a technology for bladder cancer diagnostics, a $6M IMCRC project with Corin Group on antibacterial surface modification for orthopaedic implants, and a $1.3M project with Anizop Holdings on antibacterial surface modification for dental implants.

Nanoengineered Materials and Coatings for Medicine and Beyond

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In this keynote talk, I will give an overview of recent progress from my lab on development of plasma polymer facilitated nanoengineered surfaces that benefit many areas of application. Over the years, we developed a range plasma based methods with allows us to control that entire spectrum of surface properties, including chemical, physical, mechanical and topographical. The main focus of our research is the surface modification of medical devices and biomaterials for applications in areas such as cell therapies, tissue engineering, controlling inflammation and infections as well as medical diagnostics. However, our surface modification technologies are not limited to medicine. We have demonstrated the utility of nanoengineered plasma polymers for solving problems in other areas such as environmental science and remediation, organic electronics, water treatment and wine making. I will present the engineering and chemical concepts underpinning "nanoengineering of plasma polymers" and give a range of examples of application of the technology in various fields.

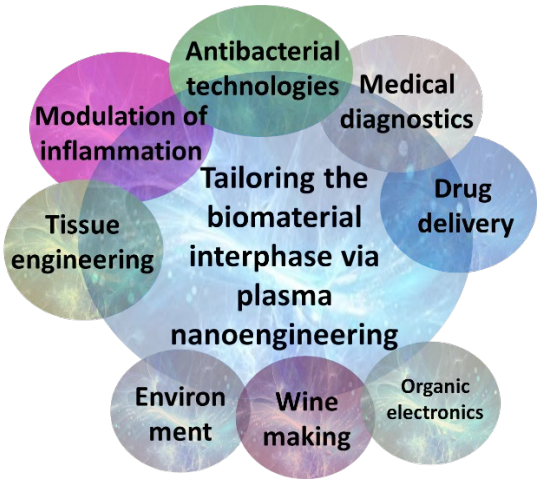

Figure 1: Applications of Plasma Nanoengineering.

References

Visalakshan et al *Advanced Functional Materials* 29 (14), 1970088 (2019)
Chen et al *ACS Nano* 11 (5), 4494-4506 (2017)
Mierczynska-Vasilev et al *Food Chemistry* 275, 154-160 (2019)
Bright et al *Nano Letters* 22, 16, 6724–6731 (2022)
Truong et al *ACS Nano* 17 (15), 14406-14423 (2023)
Hayles et al *npj Biofilms and Microbiomes* 9 (1), 90 (2023)
Nguyen et al *Advanced Functional Materials* 34 (31), 2310539 (2024)
Pham et al *Small* 20 (39), 2470290 (2024)

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Biography

Prof Kunio Ishikawa was born in Kagawa prefecture, Japan. He graduated at Department of Applied Chemistry, School of Engineering, Osaka University, Osaka, Japan in 1986, also graduated at Division of Applied Chemistry, Graduate School of Engineering, Osaka University, Osaka, Japan, and got PhD from Osaka University in 1990.

He became an assistant professor at Tokushima University, Japan in 1988, and became an associate professor at Okayama University in 1997, and became a chairman and professor at Kyushu University in 2001.

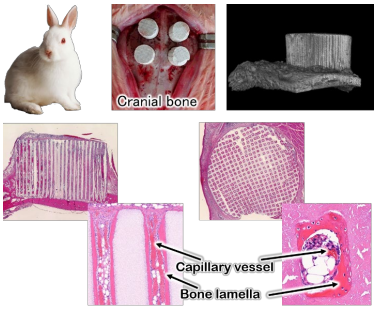
He is now serving as presidents of the Japanese Society for Biomaterials, and International Society for Ceramics in Medicine.

He is also serving as directors or councilors for many academic societies.

For governmental work, he is serving as a co-optation of Science Council of Japan, and as a senior special advisor, National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, Japan.

His research field is bioceramics especially bioceramics for bone regeneration. He found a method of fabricating carbonate apatite. Now, carbonate apatite granules are clinically available in US and Japan.

Carbonate apatite artificial bone



It should be noted that inorganic component of bone is not hydroxyapatite (HAp) but carbonate apatite (CO_3Ap). However, CO_3Ap block cannot be fabricated by sintering due to its thermal decomposition. Therefore, sintered HAp which is thermally more stable than CO_3Ap has been used in clinics as a typical artificial bone. Recently, CO_3Ap block was fabricated through dissolution-precipitation reaction using precursor blocks. For example, when $CaCO_3$ block is immersed in Na-H-PO_4 solution, it became CO_3Ap maintaining its macroscopic structure. CO_3Ap exhibit much higher osteoconductivity than HAp and replaces to new bone. At present, granular CO_3Ap is used in dental clinics in US and Japan. When bone defect is large, CO_3Ap block is preferable than CO_3Ap granules. Both dissolution-precipitation reaction and replacement of artificial bone to new bone based on bone remodeling proceed only from its surface. Therefore, interconnected porous structure is one of the keys for CO_3Ap block. One of the interconnected porous structures is a honeycomb structure. When CO_3Ap honeycomb was placed on the rabbit's cranial bone, all pores were filled with new bone in 4 weeks. Also, capillary vessels were formed along the pores. CO_3Ap honeycomb is also useful for reconstruction of segmental bone defect. Compressive strength of the CO_3Ap honeycomb was approximately 100MPa along the pores. When segmental bone defects of rabbit ulnae was reconstructed with the CO_3Ap honeycomb, new bone was confirmed even at the center of the CO_3Ap honeycomb 4 weeks after surgery. It is concluded, therefore, that CO_3Ap honeycomb is the promising block type artificial bone.

Dr Lan Xiao

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Biography

Dr Lan Xiao is an emerging leading early-to-mid career researcher in tissue engineering and regenerative medicine. Since 2011, Dr Xiao has been researching on the mechanisms of bone repair and regeneration under physical and pathological conditions, with a particular interest in osteoimmunology and biomaterial application. She started her research in biomedical engineering in QUT from 2014 and has a strong track record in the field of tissue engineering with 80 published refereed journal papers (she owns the 1st/co-1st/co-corresponding authorship in 21 of them), including those with high-impact factors (IFs, 22% of her papers were published on journals with IF>10), which have been considered top journals in the fields of Material Science and Tissue Engineering, such as Materials Today (IF: 31.041), Nano Today (IF: 20.72), Advanced Functional Materials (IF: 18.808), Bioactive Materials (IF: 16.44), Advanced Science (IF: 16.806), Autophagy (IF: 16.016), Chemical Engineering Journal (IF: 13.273), Acta Pharmaceutica Sinica B (IF: 11.413), Nano letters (IF: 11.238), Advanced Healthcare Materials (IF: 11.092), etc. Over 10% of her outputs were published in the top 1% of journals, and over 50% were published in the top 10% of journals (ranked by CiteScore, SciVal). Since her first paper was published in 2012, Dr Xiao has demonstrated her impact on the field through over 14000 citations and a H-index of 23 (according to GS). She has a Field-Weighted Citation Impact (FWCI) of 4.45, signifying her papers are cited over 4-fold higher than the fields' average. Her research has been well-recognized in the field and has been presented in 18 domestic/international conferences. Dr Xiao's research output has become more and more prominent after PhD graduation (2017), during which 75 papers were published (regardless of a 13-month career interruption). Her growing prominence can be demonstrated by the increasing numbers of published papers (4 in 2019, 5 in 2020, 9 in 2021, 23 in 2022) and especially in 2021, 14.3% of her outputs were published in the top 1% journals according to CiteScore ranking (SciVal), this number increases to 30.8% in 2022. Much of her current research work has been focused on how to regulate immune system to induce tissue regeneration (e.g., bone regeneration, cartilage regeneration, neuronal regeneration, etc). Her research has been presented in 18 domestic/international conferences, and the well-recognized research impact can be further indicated by the invited review paper from Materials Today (top 1% in the field). In less than 5 FTE years of research experience since PhD, she has co-supervised/mentored 10 HDR students and 3 visiting-scholars at QUT, co-led multiple national and international projects (contributed to 22 papers) and attracted over one million CI funding.

Photo-triggered Multifunctional Gold Hybrid Nanoflowers Promote Infectious Skin Regeneration

Lan Xiao[*,1], Jixuan Hong[#,2], Jiaqi Zhu[#,2], Xiaxin Cao[2], Jiaru Xian[2], Xueqiong Yin[2], Qiaoyuan Deng[*,3], Ziyu Qin[2], Maohua Chen[2], Chaozong Liu[4], Swastina Nath Varma[4], Yin Xiao[1], Mengting Li [*,2]

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The skin wound-healing under infection conditions remains challenging owing to the lack of efficient strategies to inhibit drug-resistant bacteria and control inflammation. Photothermal therapy showed efficient antimicrobial effects, whereas it generates excessive heat to damage tissue and inflammation to impede tissue regeneration. Herein, we develop the multifunctional gold nanoflower incorporated with photosensitizer (Ce6, for PDT) and anti-inflammatory drug (bromfenac sodium/BS) to combine the mild-photothermal therapy (mPTT), photodynamic therapy (PDT), and drug-controlled release anti-inflammation therapy for infectious skin regeneration. Upon laser irradiation, the local temperature increased (to a mild temperature of ~45 ℃, mPTT) along with the singly linear oxygen (from PDT) for anti-infection; the release of BS was triggered for anti-inflammation. The multifunctional nanoflowers achieved 99% antibacterial efficiencies and biofilm inhibition *in vitro*. They showed good biocompatibility and improved wound-healing in the animal models of subcutaneous abscess and skin wound infection with drug-resistant bacteria. In addition to the antibacterial effect from mPTT and PDT, the nanoflowers regulated the immune microenvironment by controlled-releasing BS to regulate anti-inflammatory macrophage polarization, thereby promoting growth factor production, collagen deposition, and angiogenesis to improve skin wound-healing. Therefore, this study provides an advanced nano-system with photo-triggered antimicrobial and anti-inflammation activities, which promotes infectious skin tissue regeneration.

Professor Marcelo Figueredo

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Biography

Marcelo Figueredo is a professor of periodontology at the School of Medicine and Dentistry - Griffith University, Australia. He also holds the position of affiliated to Research at the Karolinska Institutet, Sweden.

Professor Marcelo has a PhD in Periodontology and Clinical Chemistry obtained in May 1999 at the Karolinska Institutet, Sweden. His thesis is entitled “Hyperreactive neutrophils: A mechanism of tissue destruction in periodontitis”. Since then, he has dedicated his career to studying the systemic impact of Periodontal Disease and the biological complications around osseointegrated implants.

Professor Marcelo started his docent career in 1999 at the Faculty of Odontology of the Rio de Janeiro State University (FOUERJ), Brazil. He was the Dean of Research at the same University from 2010 to 2018. He has had continuous funding grants from the Brazilian National Council for Scientific and Technological Development (CNPq), the Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES), and Carlos Chagas Filho Foundation for Research Support of the State of Rio de Janeiro (FAPERJ). He has authored one book, six book chapters, and nearly 200 papers in peer-reviewed journals in both English and Portuguese. His work has been cited almost 5,000 times and has a Google Scholar h-index of 39.

TALK Title: Biological complications around Osseointegrated implants

Biological complications around osseointegrated implants are a significant concern, as highlighted by a recent systematic review based on a European consensus conference. This review revealed that the prevalence of peri-implant mucositis and peri-implantitis ranges from 19% to 65% (Derks and Tomsai 2015), which can jeopardize the longevity of reconstructions on implants. There are several types of failures associated with osseointegrated implants. Biological failures can occur early, where osseointegration is not achieved due to interference with the initial bone healing process, or late, where the initially achieved osseointegration fails to be maintained. Mechanical failures involve the fracture of implants and related suprastructures, while iatrogenic failures occur when implants are improperly aligned despite achieving osseointegration, rendering them unusable. Additionally, inadequate adaptation can lead to patient dissatisfaction due to aesthetic or psychological issues. Peri-implant mucositis, characterized by clinical signs such as inflammation, bleeding on gentle probing, erythema, swelling, and/or suppuration, can progress to peri-implantitis. Peri-implantitis is marked by inflammation, bleeding on probing and/or suppuration, increased probing depths, recession of the mucosal margin, and radiographic bone loss. Effective treatment requires specialized tools, including various types of curettes and ultrasonic devices with polyether-etherketone-coated tips. However, nonsurgical therapy for peri-implantitis has generally shown limited effectiveness, with only minor improvements and a tendency for disease recurrence. When nonsurgical treatments fail, advanced surgical techniques like access flap surgery are recommended for better decontamination.

Dr Miaomiao Liu

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Biography

Dr Miaomiao Liu is an NHMRC Emerging Leadership Fellow and an ECR Research Leader at the Institute for Biomedicine and Glycomics. She obtained a joint PhD degree in 2017 from Griffith University and the University of Chinese Academy of Sciences. She has a career total of 52 research outputs including 49 peer- reviewed publications ,1 book chapter and 2 patent applications in the field of native MS, natural product chemistry and metabolomics. Dr Liu has attracted >$4.15M in research funding ($1.34 M as CIA and $1.2M as CIB) including two fellowships (NHMRC EL1 Investigator Fellowship (2024- 2028); Japan Society for the Promotion of Science (JSPS) Fellowship, 2022-2023) and a commercial project with big pharma industry partner Genentech (CIB, 2019 – 2021).

Her multidisciplinary research program rests on three pillars:

1. Target identification by native mass spectrometry to identify the molecular target of bioactive molecules without the need to derivatise the molecule.

2. Characterising of ternary complex formed between a target protein, a PROteolysis Targeting Chimera (PROTAC) and an E3-ubqiutin ligase by native mass spectrometry.

3. Natural products chemistry by combining phenotypic-based drug discovery and target-based drug discovery to identify active compounds from natural resources.

Drug Discovery Using Native MS: Protein-Ligand Complexes and Beyond

Miaomiao Liu
Griffith University

Native mass spectrometry (native MS) relies on non-denaturing electrospray- ionisation (ESI) to recognise multi-charged proteins in their near-native states. It is a label-free, fast, and accurate method that permits the direct observation of non-covalent and covalent protein-ligand complexes (Figure 1). Over the last 5 years, we have advanced the application of native from measuring binding interactions of individual small molecules (ligands) with proteins, to screening libraries of compounds and compound mixtures, to protein mixtures, and ternary protein-ligand-protein molecular glue type complexes. Our outcomes which involved collaborations with disease experts in academia and industry include identification of new cancer, malaria, neurodegenerative diseases, tuberculosis and COVID-19 therapeutic candidates.

The current focus lies on further refining our platform to probe increasingly complex mixtures of proteins using known small molecule drugs and bioactive compounds identified from phenotypic assays where the target protein is unknown. The ultimate aim is to precisely and directly identify the target protein for every small molecule drug candidate within disease-relevant cell lysates. This ongoing development holds immense promise for advancing drug discovery and understanding disease mechanisms.

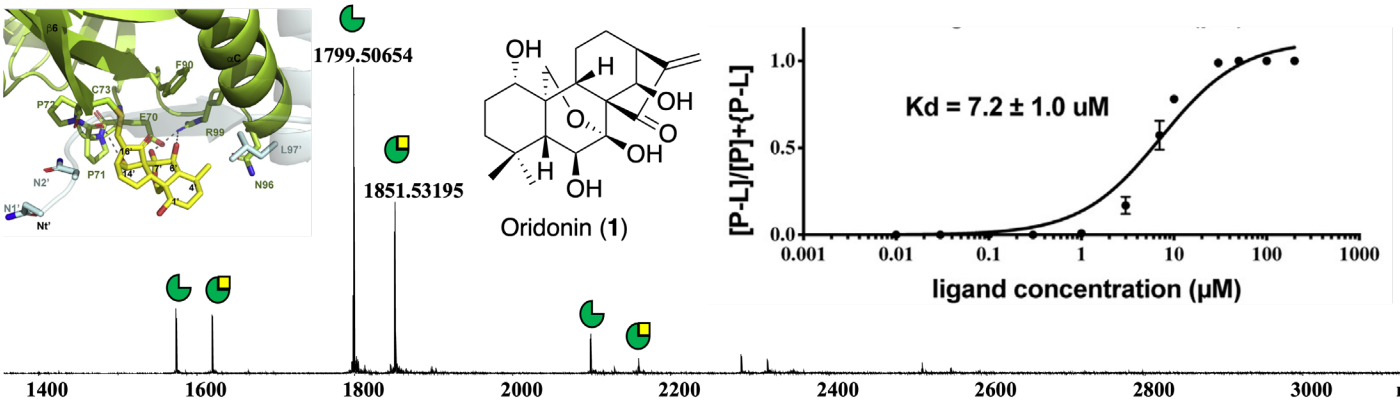

Figure 1. Native MS discovers oridonin binding to Nsp9 protein with a Kd value of 7.2 μM.

References

1. Advancing Kir4.2 Channel Ligand Identification through Collision-Induced Affinity Selection Mass Spectrometry. ACS Chem. Biol. 2024, 19, 3, 763–773
2. Discovery of Anti-SARS-CoV-2 Nsp9 Binders from Natural Products by a Native Mass Spectrometry Approach. J. Nat. Prod. 2023, 86, 12, 2630–2637
3. Drug-repurposing screening identifies a gallic acid binding site on SARS-CoV-2 non-structural protein 7. ACS Pharmacol. Transl. Sci. 2023, 6, 4, 578–586
4. Collision-induced affinity selection mass spectrometry for identification of ligands. ACS Bio&Med Chem. 2022, 2, 5, 450–455
5. A natural product compound inhibits coronaviral replication *in vitro* by binding to the conserved Nsp9 SARS-CoV-2 protein. J. Biol. Chem. 2021, 297(6): 101362-101374
6. Native Mass Spectrometry for the Study of PROTAC GNE-987-Containing Ternary Complexes. ChemMedChem. 2021, 16: 2206-2210
7. Development of a target identification approach using native mass spectrometry. Sci. Rep. 2021, 11: 2387-2398

Dr. Mo Chen

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Biography

Dr Mo Chen (BSc Hons 1), PhD, is an NHMRC research leader with an outstanding record of award-winning innovation and knowledge in the interdisciplinary field of biomedical engineering and medical biotechnology. His ground-breaking three-dimensional (3D) cell culture technology has shown immense promise in the area of spinal cord injury repair, with the potential impact of the technology recognized by the **Research Australia Discovery Award 2020-2021.**

Mo Chen has a PhD in neuroscience about spinal cord injury repair and has eight years of experience and expertise in cell biology and medical bioengineering. This includes developing cell transplantation products to treat spinal cord injury and analyzing various 3D culture systems, such as low attachment 3D culture, mammalian cell culture with bioreactors, and hydrogel-based 3D culture.

He has published 11 journal papers (10 Q1 and 1 Q2) in the last three years, with 189 citations. The most significant of these papers focused on the therapeutic properties of Olfactory Ensheathing Cells (OECs) in the spinal cord injury site and the 3D culture technique.

Chen's groundbreaking brain organoids technology, with two patents (Provisional patent number 2017904456 and 2017904064) for the root technology, and new patent applications are currently being prepared for the updated version. This new organoid technique is advantageous as it contains only cells and does not require any assistance from scaffolds, fibres, or supporting gels. His contributions to 3D cell culture are that he has broken through the limitations of traditional 3D cell production concepts and he is the first to apply cell self-organisation theory to pre-clinical research.

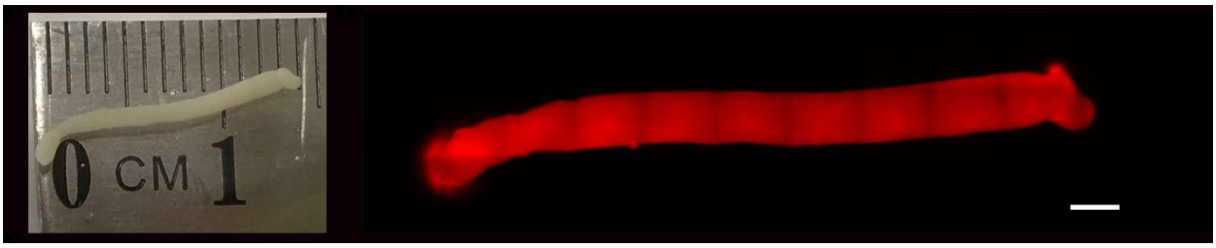
In 2023, he was awarded a Griffith University Postdoctoral Fellowship (2023-2025) and he is CIA on an MRFF ECR/MCR project (2023-2026, $762k from MRFF, $762k from partners, total project value $1.52 million). Furthermore, Dr. Chen is **the key technical member** of the Nervous System Therapy Project at the Motor Accident Insurance Commission. This specialized research project has secured a funding of **15 million dollars.**

Advancing Cell Therapy for Spinal Cord Injuries through Innovative 3D Culture Techniques

Mo Chen
Griffith University

In recent advancements, an innovative 3D cell culture technology has been developed specifically for the treatment of spinal cord injuries. By harnessing advanced 3D cell culture technologies, we have developed a system that leverages the natural self-organization of cells, promoting cellular clustering through precise interactions mediated by cell adhesion molecules and the extracellular matrix (ECM). Remarkably, this system achieves high efficiency, producing centimeter-scale 3D cultures within 24 to 48 hours without the use of synthetic scaffolds.

Building on this foundational innovation, we have further developed injectable 3D cell cultures and custom-shaped constructs that accurately replicate the morphology of damaged nerves, significantly enhancing the potential for targeted and precise tissue repair. Moreover, the experimental models we have designed provide a detailed understanding of the complex cell-cell interactions involved, offering key insights into the mechanisms underpinning the therapeutic efficacy of this approach. These advances mark a significant step forward in the clinical translation of cell therapies for spinal cord injury repair.



Professor Randy Bindra

Biography

Professor Bindra is an Orthopaedic Surgeon specialising in surgery of the hand and wrist. Besides caring for patients and training surgeons, Professor Binda has been involved in developing implants for improving function in patients after hand and wrist arthritis and injuries.

Professor Bindra has written over 50 book chapters and medical journal articles and serves on the editorial board for scientific journals. He is a passionate educator and is frequently invited to speak internationally. His dedication to teaching and the well being of junior doctors has won him the honour of 'Clinical Educator of the Year' award for the State of Queensland for 2016. He has been in clinical practice for over 20 years and has been recognised in "Best Doctors in America" and "Chicago's Top Doctors". Professor Bindra is an innovator in his field having designed surgical implants and techniques used in hand surgery throughout the world.

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TALK Title

REGENERATING A WRIST LIGAMENT:
From benchtop to clinical use.

Dr Reuben Staples

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Biography

Dr. Reuben Staples is a biomedical engineer specializing in 3D-printed scaffolds for bone and soft tissue regeneration. His work focuses on developing patient-specific solutions, with expertise in melt electrowriting and bioresorbable polymer-based devices for orofacial applications. As the lead engineer on a groundbreaking project, Dr. Staples successfully developed and translated a high-risk bioresorbable scaffold into clinical trials, marking a world-first achievement. This innovation established The University of Queensland as the first institution in Australia to manufacture Class III medical devices on-site under ISO 9001-certified Quality Management Systems.

Early in his career, Dr. Staples participated in the Industry Mentoring Network in STEM: Engage program, where he gained valuable experience bridging academia and industry. This foundation has informed his ability to navigate complex translational pathways.

Recognized as an emerging leader in the field, Dr. Staples was invited by Engineers Australia to deliver a national CPD webinar on personalized medical devices and research-led translation, further establishing his reputation as a rising expert in biomedical engineering and translational research.

Research to Real-World Impact: Aligning ISO Standards and TGA Guidelines with Translational Innovation

An introduction to ISO standards and TGA guidelines underscores their essential role in the development and translation of medical devices. These frameworks bridge the gap between research innovation and regulatory compliance, ensuring the safety, quality, and effectiveness of emerging medical technologies. Dr. Reuben Staples will present a case study on the development of patient-matched 3D-printed implants, showcasing the practical application of design controls and quality management systems to derisk technologies for commercial adoption. This talk will provide insights into aligning academic research with regulatory requirements to accelerate the translation of innovative solutions into impactful clinical outcomes.

Dr. Ruiqiang Hang

Associate Professor

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Biography

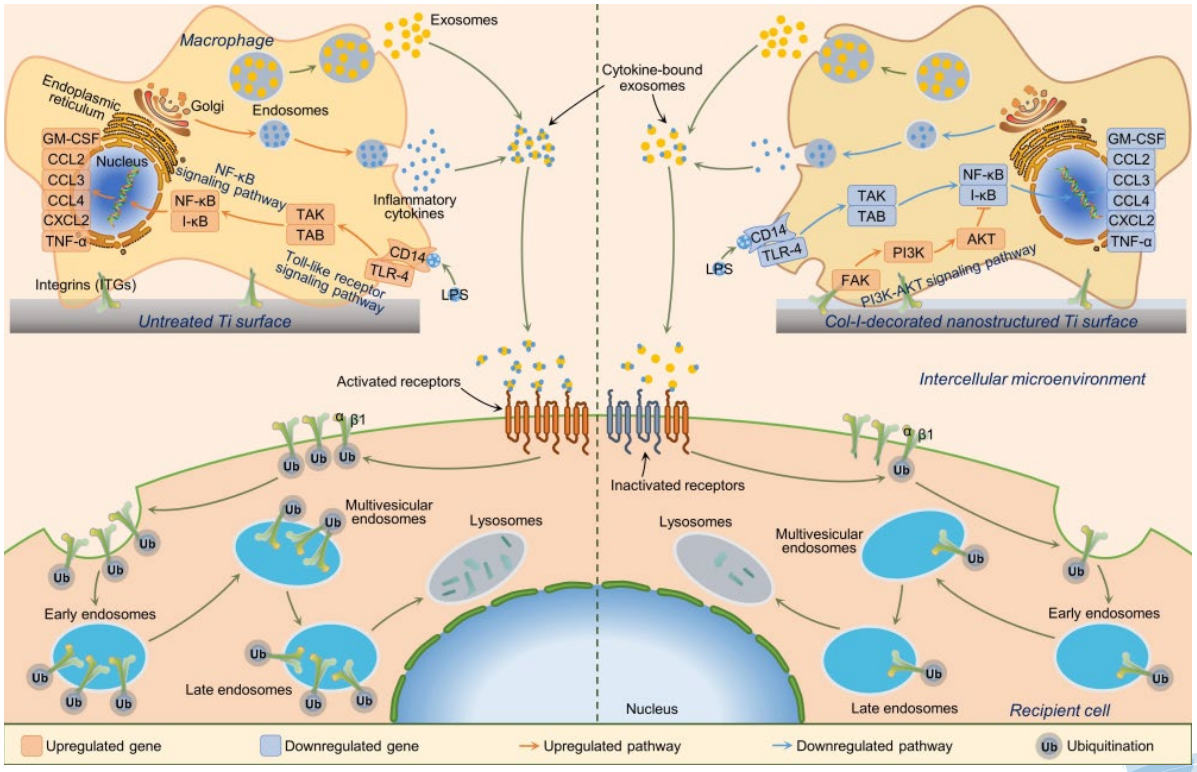
Ruiqiang Hang is an associate professor at the School of Materials Science and Engineering at Taiyuan University of Technology. His research interests mainly focus on medical titanium alloys and their surface modifications. He is currently an outstanding young academic leader in Shanxi Province, the head of the Biomedical Materials Innovation Team in Shanxi Province, a member of the Medical Metal Materials Branch of the Chinese Society for Biomaterials, a member of the Rehabilitation Devices and Biomaterials Branch of the Chinese Society for Biomaterials, and a member of the Surface Engineering Branch of the Chinese Mechanical Engineering Society. As first/corresponding author, he has published more than 100 academic papers, which have been cited more than 5000 times. He has led more than 10 scientific research projects, and has been granted more than 10 national invention patents. His research achievements have won the second prize of Shanxi Natural Science Award for three times.

Biomaterial Surface-Mediated Macrophages Exert Immunomodulatory Roles by Exosomal CCL2 Induced Membrane Integrin β1 Trafficking in Recipient Cells

Ruiqiang Hang[1], Yuyu Zhao[1], Xiaohong Yao[1]

[1] Shanxi Key Laboratory of Biomedical Metal Materials, College of Materials Science and Engineering, Taiyuan University of Technology, Taiyuan 030024, China

The interaction between biomaterials and the immune system is a critical area of research, especially in tissue engineering and regenerative medicine. A fascinating and less explored aspect involves the immunomodulatory behaviors of macrophage (MΦ)-derived exosomes induced by biomaterial surfaces. Herein, untreated surface, nanostructured surface, and type I collagen (Col-I)-decorated nanostructured surface of titanium implants were chosen to culture MΦs, followed by extraction of MΦ-derived exosomes and investigation of their immunomodulatory functions and mechanisms. The results showed that the exosomes in the untreated group carried plenty of inflammatory cytokines, predominantly CCL2. After targeting recipient cells, the CCL2 on the exosomes could specifically bind to its receptor CCR2, triggering downstream signaling pathways to induce internalization of membrane integrin β1 and targeted lysosomal degradation, consequently suppressing the functions of recipient cells. In contrast, the exosomes in the nanostructured group, especially Col-I-decorated nanostructured group carried few CCL2, moderating their inhibition on the functions of recipient cells. These findings not only clearly show that CCL2 is a key constituent of exosomes involved in the interaction between biomaterials and host immune system, but also potentially a key target for designing advanced biomaterials to promote tissue repair and regeneration.



Dr Sha Pather

Chief Operating Officer

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Biography

Dr. Sha Pather is a Chartered Professional Engineer (CPEng, RPEQ) with a PhD in Medical Device Design and over a decade of experience in the field. He has led engineering teams in the development and regulatory approval of a diverse range of products, including medical implants, instrumentation, software, and AI-driven solutions.

Previously serving as Chief Technology Officer at Field Orthopaedics in Brisbane, Queensland, Dr. Pather spearheaded the development of groundbreaking implants for fracture fixation. His innovative projects redefined the boundaries of design and manufacturing, resulting in globally adopted implants and instruments. Throughout his career, he has secured numerous patents and achieved multiple regulatory approvals, including FDA (USA), CE Marking (Europe), and TGA (Australia).

Dr. Pather is deeply versed in quality management systems - ISO 13485 and MDSAP standards, and has played a pivotal role in helping Akunah secure these certifications. Currently, as the Chief Operating Officer at Akunah, he continues to focus on advancing the company's capabilities in operations, design, regulatory compliance, and quality management.

Bridging the Gap: Key Strategies for Medical Device Design and Regulatory Success

Translating research into clinically implemented medical devices presents a significant challenge for both research organizations and the medical device industry. A key barrier is the widespread misunderstanding of essential requirements for medical device design and regulatory approval. Misconceptions about the purpose and scope of regulatory approval, associated responsibilities, and compliance pathways often hinder progress, delaying patient access to safe and effective technologies.

Streamlining the transition from research to clinical application is crucial for enabling timely access to healthcare advancements. Central to this process is the need to demonstrate that a medical device is safe and effective in relation to its associated risks, a critical component of regulatory approval. Employing strategies such as risk-based design methods, design controls, and validation planning not only establishes a solid foundation for the design process but also provides vital justification for regulatory approvals. By prioritising safety and efficacy throughout the development lifecycle, researchers and product developers can maximise the success of medical devices post-implementation.

Additionally, three key concepts should be clearly understood during the planning of translational research and medical device development:

- Proposal of Intended Use
- Identification of Equivalent Technology
- Assignment of Device Classification

By integrating these regulatory considerations early in the process, researchers and developers can establish a clear and efficient path for research and validation activities. This ensures a smooth journey through the complex regulatory landscape, enabling compliance while facilitating the delivery of innovative and impactful healthcare solutions.

Professor Songtao Shi D.D.S., Ph.D

Professor and Research Center Director

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Biography

Songtao Shi, D.D.S., Ph.D., is Professor and Research Center Director at the **Sun Yat-sen University**. Dr. Shi received his D.D.S. degree and certificate in Pediatric Dentistry from the **Peking University** School of Stomatology and Ph.D. in Craniofacial Biology from the **University of Southern California**. Prior to joining the faculty at the Sun Yat-sen University, he served as a Principal Investigator and Clinical Fellow for nine years at the National Institute of Dental and Craniofacial Research (**NIDCR/NIH**), a professor for more than eight years at the **University of Southern California** and professor and department chair for more than four years at the **University of Pennsylvania** School of Dental Medicine.

His research program focuses on understanding mechanism of mesenchymal stem cell (MSC)-associated diseases and exploring feasibility of translating research discoveries to clinical therapies. His team was **the first to identify dental pulp stem cells (DPSCs), baby tooth stem cells (SHED), periodontal ligament stem cells (PDLSCs), root apical papilla stem cells, tendon stem cells, gingival stem cells (GMSCs), sclera MSCs, and benign tumor MSCs from keloid**. These novel and landmark discoveries have opened opportunities for scientists to investigate oral tissue-derived stem cells and their use for tissue engineering, disease modeling, and clinical treatment. According to the clinicalTrials.gov, there are 21 clinical trials using DPSCs, SHED, PDLSCs, and GMSCs to treat a variety of human diseases.

In translational study, Dr. Shi's team and their collaborators have used these stem cells to regenerate a variety of tissues, including dentin, pulp, periodontal ligament, tendon, bone, bio-root in preclinical animal models. Dr. Shi and his collaborators are **the first to use MSCs to treat systemic lupus erythematosus (SLE) and use dental stem cells to regenerate dental pulp and periodontal tissues in patients**. Also, Dr. Shi and his collaborators are **the first to use dental stem cells to treat systemic diseases such as type 2 diabetes and depression patients**.

To understand mechanisms of MSC-based therapies, Dr. Shi's team was **the first to reveal that recipient immune cells regulated cell-based bone regeneration**. Dr. Shi and his collaborators are **the first to discover that epigenetic regulation determined the therapeutic effect of MSC** transplantation in human and mouse models. Additionally, Dr. Shi's team is **the first to identify the role of H_2S in regulating stem cells and Tregs**. Dr. Shi has published more than 200 peer-reviewed articles in a variety of high-impact scientific journals such as *Nat Medicine*, *Nature Biotechnology*,*Cell*, *Cell Stem Cell*, *Cell Metabolism*, *Immunity*, *Lancet*, *Sceiece Translational Medicine*. According to the google scholar, Dr. Shi's publication has been cited over 70,000 times and acquired 113 h-index.

Clinically, Dr. Shi hold Dental Licensure of State of California and had experience working at NIH hospital and private practice section in USA. This background makes Dr. Shi a highly qualified translational researcher to use stem cells in clinical setting. Dr. Shi is recipient of the 2013 IADR Distinguished Scientist Award for Pulp Biology & Regeneration and the 2020 Outstanding Contribution Award from the Society of Oral Medicine (Chinese Stomatology Association). His service has also included: Scientific Advisory Boards for the Journal of Endodontics, the Scientific Committee of Chinese Stomatology Association, and the Scientific Committee of Chinese Military Stomatology Research Institute/State Key Laboratory. Dr. Shi was Distinguished Visiting Professor in the Fourth Military Medical University and Tongji University, Visiting Professor in XiangYa School of Medicine & Stomatology, Central South University (CSU), and distinguished visiting professor in Dankook University, Korea.

Mesenchymal Stem Cells and Apoptotic Extracellular Vesicles in Translational Research

Songtao Shi

Sun Yat-sen University

Mesenchymal stem cells (MSCs) are multipotent postnatal stem cells capable of regenerating mineralized and non-mineralized tissues and interplaying with various immune cells. MSCs are widely used to treat a variety of autoimmune diseases, such as systemic lupus erythematosus (SLE), graft versus host disease, diabetes, rheumatoid arthritis, autoimmune encephalomyelitis, inflammatory bowel disease and multiple sclerosis. However, detailed mechanism by which MSC transplantation (MSCT) offers effective immune therapies is not fully understood. Our recent studies showed that MSCT induces recipient bone marrow cell aggregation to generate a neutrophil-dominated extracellular vesicle (EV) storm in SLE mice. Mechanistically, TNFa is prerequisite for bone marrow cell aggregation since it activates ICAM1 to initiates bone marrow cell migration to form the aggregates. Moreover, BM cell aggregation activates RAB11 expression to generate EV storm. Interestingly, blockade of EV storm abolished MSCT-mediated therapeutic effect in SLE mice, suggesting the responsive recipient EV storm is required for MSCT. In addition, MSC-derived apoptotic extracellular vesicles (apoVs) possess promising therapeutic potential for a variety of diseases such as osteoporosis, systemic lupus erythematosus, arthritis, colitis, wound healing and hair regeneration. Our findings demonstrate that MSCT and apoV therapies use multiple mechanisms to ameliorate disease phenotypes.

Professor Anthony Weiss AM

PhD FTSE FRSN FRSC FRACI CChem FAIMBE FNAI FBSE FTERM

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National Health and Medical Research Council Leadership Fellow

Professor of Biochemistry and Molecular Biotechnology

Immediate Past President, TERMIS

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Biography

Professor Weiss is the McCaughey Chair in Biochemistry, NHMRC Senior Leadership Fellow, and Professor of Biochemistry & Molecular Biotechnology. He leads Tissue Engineering & Regenerative Medicine in the Charles Perkins Centre at the University of Sydney.

Awards include Prime Minister's Prize for Innovation, Premier's Prize for Science & Engineering Leadership in Innovation, Eureka Prize for Innovation in Medical Research, Australian Academy of Technology & Engineering's Clunies Ross Medal, Australian Academy of Science's Ian Wark Medal, Royal Australian Chemical Institute Weickhardt Medal, Royal Australian Chemical Institute Applied Research Medal, Australasian Society for Biomaterials & Tissue Engineering's Award for Research Excellence, Innovator of Influence Award, NIH Fogarty International Fellow, Fulbright Scholar, and the Order of Australia.

He is on 14 Editorial Boards, authored >300 publications, and is inventor on 174 awarded international patents in 22 patent families covering human tropoelastin, which gives tissue its elasticity and enhances the repair of scars and wounds.

His society leadership roles include President of the Tissue Engineering and Regenerative Medicine International Society (TERMIS), Chair of TERMIS Asia Pacific, and President of MBSANZ. He is Fellow of the Australian Academy of Technology and Engineering, Royal Society of NSW, Royal Australian Chemical Institute, Royal Society of Chemistry, Royal Society of Biology, American Institute for Medical & Biological Engineering, US National Academy of Inventors, and Biomaterials Science & Engineering, and Tissue Engineering & Regenerative Medicine.

He founded the clinical stage company Elastagen Pty Ltd which was spun off from the University of Sydney to commercialize tropoelastin. Benefitting from a remarkable executive and board, Elastagen was acquired by AbbVie, one of the world's largest biopharmaceutical companies, through one of the largest transactions completed in the Australian life science sector.

Leveraging tropoelastin mechanobiology and assembly to enhance wound repair

Elastic fibres provide the structural support and elastic recoil required for the continuous mechanical stretching and recovery of soft force-bearing tissues with durability and persistence. The major component of these fibres is elastin, formed via extensive crosslinking of the monomer precursor tropoelastin. An emerging model for tropoelastin is that it delivers this potency by emulating the mechanobiology of extracellular matrix interactions including those through development and repair, even though it is delivered as a monomer in solution. We have utilised this approach to enhance skin wound repair in animals and humans, demonstrate that purified human tropoelastin can significantly repair the infarcted heart in a rodent model of myocardial infarct, and convert implant tubes into self-organised neovessels in aorta-interposition studies. These powerful demonstrations of elastic versatility are enhanced by multiple clinical trials and the commercial translation of tropoelastin technology.

Professor Yuelian Liu

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Biography

Yuelian LIU is an associate professor in the section oral cell biology at ACTA, VU University and University Amsterdam, the Netherlands. She worked in Shanghai, China; Leuven, Belgium; Bern, Switzerland and ACTA, the Netherlands as a clinician (maxillofacial surgeon) and research scientist internationally. She is a research group leader and a supervisor of PhD students and researcher. She has received more than ten internationally recognized scientific awards. She has applied five patents in the field of biomaterial and bone regeneration and more than 20 international research grants. She is an honorary professor for several Universities internationally. She lectures widely at national and international conferences.

Professor Travis Klein

Biography

Professor Travis Klein is the leader of the Cartilage Regeneration Laboratory (CRL) at Queensland University of Technology. The CRL develops functional biomaterials, 3D cell culture systems, biofabrication approaches, and mechanical stimulation technologies to improve our understanding and treatment of orthopaedic pathologies, cardiovascular disease, and cancer.

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Bioprinting the tumour environment

Breast cancer is the second leading cause of cancer-related deaths in women, and an estimated 2.3 million new cases were diagnosed worldwide in 2022. Traditional 2D cell culture models have long been used in cancer research and drug development. However, they do not accurately mimic the cellular and extracellular matrix complexity of the tumor microenvironment, and up to 90 % of promising drug candidates fail at clinical trials. Therefore, we need better models to develop better therapies.

3D extrusion-based bioprinting is a powerful tool for developing tissue-like constructs, enabling precise patterning of cells and biomaterials into complex structures. While significant strides have been made in replicating aspects of the *in vivo* breast tumour environment through bioprinting, several limitations persist, including limited extracellular matrix complexity, cellular heterogeneity and incorporation of vascular-like network formation, a critical process required for cancer progression. Here, we will present a range of bioprinted breast cancer models with varying complexity based on photocrosslinkable gelatin bioinks. We will discuss workflows for developing bioinks, and the effects of mechanical and biochemical properties, as well as inclusion of various cancer-associated cell types in bioprinting of the tumour microenvironment.

Biomimetic Calcium Phosphate Bone Substitutes: Preclinical Development and First-in-Human Clinical Trial Results

Yuelian Liu

ACTA, VU University and University Amsterdam

Biomimetic synthetic bone substitutes represent a significant advancement in bone defect management, offering numerous opportunities to enhance bone repair and address associated complications. The incorporation of bioactive agents, such as bone growth factors and therapeutic drugs, marks a new era of precision in orthopedic care. Of particular interest is the controlled local delivery of anti-inflammatory and anti-cancer pharmaceuticals, offering a groundbreaking approach to optimize therapeutic efficacy in a wide range of clinical applications.

This research focuses on the development and clinical translation of a novel drug delivery system designed for targeted release of pharmacological agents. The core innovation centers on the refinement of beta-tricalcium phosphate (β-TCP), a widely used biocompatible ceramic, through the precise incorporation of minute doses of bone morphogenetic protein 2 (BMP-2). Rigorous preclinical testing established the efficacy of this novel BMP-2-infused β-TCP scaffold in promoting accelerated bone regeneration. In vitro studies demonstrated enhanced osteoblast proliferation and differentiation, coupled with reduced inflammation. In vivo studies using critical-sized bone defects in a suitable animal model confirmed significant improvements in bone healing rates and overall bone quality compared to control groups. These preclinical findings provided a robust foundation for the subsequent clinical trial.

A prospective, a clinical trial was conducted to evaluate the safety and efficacy of the BMP-2-incorperated β-TCP scaffold in a cohort of 40 patients with the extraction socked healing model. Patients were followed for 6 weeks using standardized clinical assessments, including radiological imaging (X-rays, CT scans), bone densitometry, and functional outcome measures. The results of the clinical trial demonstrated a statistically significant improvement in the new bone formation within 6 weeks. These clinical findings strongly support the safety and efficacy of the BMP-2-incorporated into β-TCP scaffold.

Beyond BMP-2, the versatility of this drug delivery platform extends to a wide range of therapeutic agents. Further research investigated the delivery of various water-soluble medications using thistechnique. The results demonstrated successful delivery and sustained release profiles for several tested compounds, underscoring the platform's adaptability. Of note is the promising potential of curcumin, a naturally occurring polyphenol with known anti-inflammatory and anti-cancer properties. In vitro studies showed that the controlled release of curcumin effectively inhibited the growth of cancer cell line, e.g., osteosarcoma cells and reduced the production of pro-inflammatory cytokines. This opens avenues for utilizing this platform in the treatment of bone tumors and other inflammatory bone pathologies.

In conclusion, this research presents a significant advance in the field of biomimetic bone substitutes, demonstrating the successful translation of a novel drug delivery system from bench to bedside. The controlled release of BMP-2 from a refined β-TCP scaffold resulted in accelerated bone regeneration and healing in both preclinical and clinical settings. The versatility of this platform further extends its potential for delivering a range of therapeutic agents, offering a powerful tool to improve clinical outcomes and patient well-being in bone defect management.

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Biography

Dr. Yang Zhang obtained his PhD from the School of Dentistry, Radboud University Nijmegen under the supervision of Prof. John Jansen and is currently the principal investigator of TERM Lab at School of Dentistry, Shenzhen University. His research is mainly engaged in regenerative dentistry, Osteoimmunology, stem cells and extracellular vesicles. In past years, he has more than 50 publications in the field of tissue engineering and regenerative medicine such as Biomaterials, Acta Biomaterialia, Asian Journal of Pharmaceutical Science, Stem Cell Research & Therapy and has an h-index of 23. He serves as the editor of *BMC Biomedical Engineering* and *Extracellular Vesicles and Circulating Nucleic Acids*.

Emerging Role of Osteoclasts and their Extracellular Vesicles in Bone Remodeling

Yang Zhang[1,2,3], Abdullah Faqeer[1,2], Shuping Zhao[1,3], Bilu Xiang[1,3], Huanan Wang[4]

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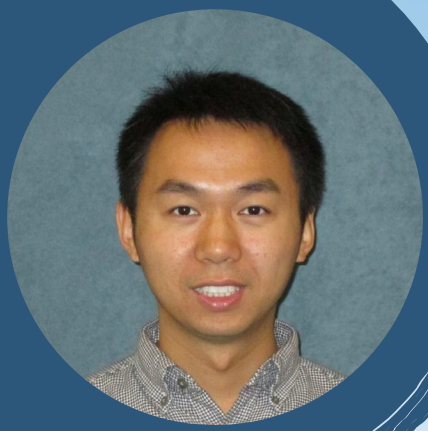
Bone remodeling is a tightly coupled process between bone-forming osteoblasts (OBs) and bone-resorbing osteoclasts (OCs) to maintain bone structure throughout life. However, the mechanisms responsible for the coupling between OCs and OBs have not been fully elucidated.

We delved into the bone healing process through immunohistochemical staining. We examined how osteoclasts influence the osteogenic differentiation of MSCs using a co-culture method in vitro. Additionally, we evaluated bone regeneration potential in vivo by utilizing tibia bone defect models. To better understand the intricate interactions between OBs and OCs, we employed proteomic and functional analysis techniques to uncover the underlying mechanisms.

We first observed that osteoclasts proceed earlier than bone formation by osteoblasts in the bone healing process, and osteoclasts display a species-independent stimulation of osteogenic differentiation on MSCs. We further validated that extracellular vesicles by osteoclasts (OC-EVs) mainly contributed to this process and demonstrated the efficacy of OC-EVs in treating tibial bone defects. It is further revealed that mature osteoclasts secrete thrombin-cleaved phosphoprotein 1 (SPP1) through extracellular vesicles which triggers MSCs osteogenic differentiation into OBs by activating TGFβ1 and SMAD3 signaling. This biological mechanism implies a paradigm shift regarding the role of osteoclasts and their signaling toward the treatment of skeletal disorders that require bone formation.



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Biography

Dr. Yun Shi obtained his PhD in Chemistry from Simon Fraser University (Canada) in 2015, after which he relocated to Griffith University (Australia) for his postdoctoral work in biochemistry and early drug discovery. With a Griffith University Postdoctoral Fellowship (2016), Dr. Shi established a fragment-based drug discovery platform using nuclear magnetic resonance (NMR) spectroscopy as the primary technique. His current research focuses on understanding the molecular mechanisms for the function and inhibition of enzymes involved in nicotinamide adenine dinucleotide (NAD^+) metabolism. These include Toll/interleukin-1 receptor (TIR) domains, many of which are enzymes involved in innate immunity and neurodegenerative diseases. His work has led to quality publications in high-impact journals such as Science, Molecular Cell, Neuron, and Science Advances. Dr. Shi was recently awarded an ARC DECRA grant to further his research on the structure and function of NAD^+ catabolites as well as an NHMRC Investigator Grant to continue his work on understanding the molecular basis of an NAD^+ synthase and developing small-molecule modulators for neuroprotection.

Targeting NAD^+ Metabolism Against Neurodegeneration

Nicotinamide adenine dinucleotide (NAD^+), an essential metabolite in all living cells, plays critical roles in maintaining neuronal health and protecting against neurodegenerative diseases. An NAD^+ glycohydrolase, SARM1, has been identified as a key driver of axonal NAD^+ depletion and degeneration in response to mechanical or chemical insults to neurons. Inhibition of the NAD^+ glycohydrolase activity of SARM1 has shown promise in slowing axonal degeneration and even promoting recovery. Our recent work has uncovered the molecular mechanisms underlying SARM1 regulation, activation, and inhibition by small molecules. These findings have established SARM1 as a druggable target for preventing NAD^+ depletion and axonal degeneration, offering new therapeutic avenues for treating neurodegenerative diseases.

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Biography

Professor of Oral Implantology at the Hospital of Stomatology, Sun Yat-sen University. His academic positions include Vice Chairman of the Oral Implantology Committee of the Chinese Stomatological Association, Vice President of the IADR Implant Group, Honorary Professor at the Faculty of Dentistry of the University of Hong Kong, and ITI Fellow of the International Team for Implantology.

Dr. Chen has published over 40 papers as the corresponding author in prestigious journals such as Nature Communications, Advanced Functional Materials, Advanced Science, Bioactive Materials, Acta Biomaterialia, Journal of Dental Research, Clinical Oral Implants Research, and The International Journal of Oral & Maxillofacial Implants. He has driven the clinical translation of his research group's findings on "fluorinated bio-derived hydroxyapatite." This was achieved through a multicenter, randomized, single-blind, parallel-controlled clinical trial assessing the safety and efficacy of bone repair materials for alveolar bone defects or insufficiency.

Fluorinated Porcine-Derived Guided Bone Regeneration Materials: From Concept to Practice

Achieving successful bone regeneration and repair is a critical concern in oral implantology. Guided Bone Regeneration (GBR) materials, including bone substitute and barrier collagen membranes, provide scaffolding for stem cells and osteoblasts, stabilize blood clots, and protect the bone regeneration area from rapid soft tissue overgrowth. Porcine-derived GBR materials, resembling human tissues in composition and structure, offer advantages such as biocompatibility, biodegradability, and availability. Despite their benefits, challenges like surgical volume instability and uncontrolled degradation rates persist. Recent research focuses on optimizing GBR materials by incorporating trace elements like fluoride ions, which show promise in bone metabolism and immune regulation. We developed fluoride-doped porcine-derived hydroxyapatite (FPHA) from cancellous pig bone, enhancing its compressive strength and biological efficacy. Studies demonstrate that fluoride-doped PHA promotes osteogenic differentiation, inhibits osteoclast formation, and enhances angiogenesis. *In vivo* studies across various models confirmed effective bone defect repair, and a multicenter clinical study showed comparable performance to bovine bone substitutes. Combining FPHA with collagen also showed promising angiogenic and osteogenic capabilities *in vitro* and in rat cranial defect models. A fluoride-modified biomineralization strategy further improved collagen membranes' barrier performance. Over the past decade, extensive research has established the potential of fluorinated porcine-derived GBR materials as reliable bone substitutes in dental implantology, warranting further clinical practice and research.

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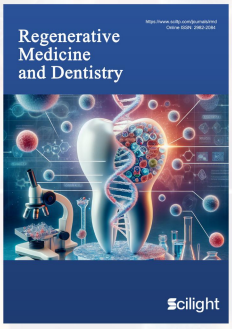
Journal Introduction



Regenerative Medicine and Dentistry (RMD) is a peer-reviewed, open-access, international journal published quarterly online by Scilight Press. The journal aims to provide a comprehensive platform for the dissemination of pioneering research and advancements in regenerative medicine and dentistry. It seeks to foster interdisciplinary research, drive innovation, and translate scientific discoveries into clinical applications that improve patient outcomes.

Journal Scope

The journal covers a broad range of topics within regenerative medicine and dentistry, including but not limited to:

- **Stem Cell Research:** Stem cell isolation, characterization, and differentiation, as well as their application in tissue engineering and regenerative medicine.
- **Tissue Engineering:** Scaffold development and strategies for tissue and organ regeneration, fabrication techniques, and 3D bioprinting.
- **Regenerative Approaches in Medicine and Dentistry:** Advanced technologies in regenerative medicine and dentistry.
- **Biomaterials:** Design and synthesis of novel biomaterials for dental and medical applications, biocompatibility, biodegradability, and functionalization of biomaterials in regenerative medicine.
- **Clinical Applications and Translational Research:** Translational studies that bridge laboratory findings with clinical practice and clinical trials in regenerative medicine and dentistry.
- **Cell and Gene Therapies:** Cellular therapies in regenerative medicine and dentistry, immunomodulation and cell-based therapy for degenerative disease, injury, and tissue regeneration, advanced gene editing technologies such as CRISPR/Cas9, and gene delivery in the therapeutic application of tissue regeneration.

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Huizhou Videya Technology Co., Ltd., founded in 2011, is a professional manufacturer and supplier of dental instruments, integrating R&D, production, marketing, and after-sales service.

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REGEN-αGEEK is a company initiated from the scientific and technological achievements of the First Prize of the National Science and Technology Progress Award. Based on nearly two decades of clinical translational research in stem cells and regenerative medicine, the company dedicated to creating the DASEA bio-manufacturing platform, to achieve the "5" goals for the scalable manufacturing of biological products such as cells and exosomes: Digitalized, Automated, Scalable, Enclosed, Activated.

The DASEA platform effectively addresses the limitations inherent in the traditional petri dish-based methods for large-scale cell cultivation. It achieves a notable reduction in the costs associated with cell production, concurrently enhancing the quality and stability of the cells. This platform offers an integrated solution tailored to meet the industrial-scale cell and derivative preparation needs of clients within the downstream cellular industry. The stem cells and exosomes prepared by DASEA have obtained quality inspection reports from the NIFDC and been recognized by China NMPA, as well as several large tertiary hospitals to conduct multiple clinical trials (incl. COVID-19 and dry eye syndrome). These clinical studies have demonstrated excellent therapeutic outcomes. REGEN-αGEEK is dedicated to “Making regeneration clinically accessible and affordable”.

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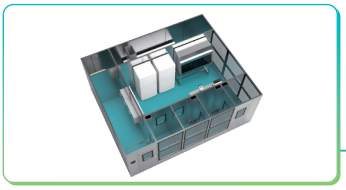

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