BORS 2026 Annual Meeting

8–9th September 2026

Technology and Innovation Centre
University of Strathclyde, Glasgow

CONFERENCE BOOKLET

BORS 2026 Local Organising Committee

Dr Philip Riches, Dr Jonathan Williams (University of Strathclyde)

Dr David Hamilton (Glasgow Caledonian University)

Prof Matthew Dalby, Mrs Claire Carberry (University of Glasgow)

Dr Ian Kennedy (Queen Elizabeth University Hospital)

Prof Jon Clarke (NHS Golden Jubilee)

Gold Sponsor

Sponsors

Welcome from the BORS President

Professor Ines Reichert
President, British Orthopaedic Research Society

It is a great pleasure to welcome you to Glasgow for the 2026 BORS meeting.

BORS has a strong tradition of **bringing clinical and basic science together**, and strengthening this connection remains central to our mission. The questions that matter most in orthopaedic research sit at the interface between disciplines: clinical observations should stimulate fundamental research, while discoveries in the laboratory must ultimately improve patient care. We regularly contribute sessions to the **British Orthopaedic Association**, our umbrella organisation. The ongoing relationship between BORS and specialist orthopaedic clinical societies is one of our top priorities.

We also would like to extend our **international connections**. Within the framework of ICORS we will continue our strong relationships with research societies internationally. We have conducted workshops at EORS, ICORS and will be at the ORS in 2027. Our **Travelling Fellowships** have been particularly valuable for early-career researchers, creating opportunities to experience different research environments and build lasting collaborations. We are keen to expand these opportunities to collaboration with EORS and European centres.

Our close relationship with the **Bone & Joint Research Journal** is another important facet of our society, providing an excellent platform for sharing high-quality, clinically relevant science and opportunity with opportunities for mid-career scientists to get involved as Associate Editors.

BORS is a registered **Charity** and committed to public outreach usually via public engagement sessions. Lastly, BORS is an open-minded society where **everyone can contribute and thrive**. Diversity, and belonging, strengthen science and leads to successful collaborations. Our 'nature' is interdisciplinary, between disciplines and transcendent across career grades. Working with established structures we need to be particularly mindful of overcoming bias in opportunities, recognition, career progression and leadership.

I hope this meeting will be an opportunity to share excellent science, develop new collaborations and enjoy the community that makes BORS what it is.

Please join us for the AGM to stay involved in shaping the future of the society.

Welcome to Glasgow, and I wish you all a stimulating meeting.

Ines LH Reichert

Welcome from the Local Organising Committee

On behalf of the Local Organising Committee, we are delighted to welcome you to Glasgow for the BORS 2026 Annual Meeting. We hope the programme provides an enjoyable mix of clinical, biological, engineering and translational research, together with plenty of opportunities for discussion, collaboration and catching up with colleagues from across the orthopaedic research community.

We are particularly grateful to our invited speakers, session chairs, presenters, sponsors, volunteers and everyone who has contributed to making the meeting possible.

We hope you enjoy the scientific programme, the poster sessions, the company, and a proper Glasgow welcome over the next two days.

Local Organising Committee

Dr Jonathan Williams and Dr Philip Riches — University of Strathclyde
Dr David Hamilton — Glasgow Caledonian University
Dr Ian Kennedy — Queen Elizabeth University Hospital
Prof Jon Clarke — NHS Golden Jubilee
Prof Matthew Dalby and Mrs Claire Carberry — University of Glasgow

Essential Conference Information

Venue
Technology and Innovation Centre
University of Strathclyde, Glasgow

Conference dates
Tuesday 8 – Wednesday 9 September 2026

Registration
Main Foyer, Technology and Innovation Centre
Registration opens from **08:30** on both conference days.

Main scientific sessions and BORS AGM
Auditorium 1, Technology and Innovation Centre

Wi-Fi
Network: **TIC Conferences**
Password: **CathkinBraes**

Posters
Poster presentations will be displayed throughout both days of the conference. Presenters are asked to put their posters up from **08:30 on Tuesday 8 September** and leave them on display until the end of the meeting. Poster boards are numbered to correspond with the poster numbers in this booklet.

BORS Bash – Conference Dinner
Tuesday 8 September, 19:00
University of Strathclyde Students' Union
Welcome drink from **19:00**, with dinner served from **19:30**.

Conference website

Scan for the latest BORS 2026 information and programme.

Conference Programme

Day 1 – Tuesday 8th September 2026

Time	Programme
08:30–09:00	**Registration Opens**
09:00–09:10	**Welcome**
09:10–10:50	**Session 1: Clinical Orthopaedics** Session chair: Ian Kennedy
09:10–09:40	**Keynote 1: Translational orthopaedics ...are we there yet ??** **Neal Millar, Professor of Orthopaedics, University of Glasgow. Academic Consultant Orthopaedic Surgeon, Queen Elizabeth University Hospital**
09:40–09:50	Inequalities in the use of total hip replacement to treat hip fracture: a population-based study James Webster
09:50–10:00	The gut microbiome as a reservoir of pathogens and antimicrobial resistance in orthopaedic infection Christopher Deacon
10:00–10:10	Patient-Specific Periprosthetic Fracture Risk Calculator in Total Hip Arthroplasty: A Multicenter Update Milos Brkljac
10:10–10:20	Population-level associations of BMI and physical activity with chronic pain, osteoarthritis, and joint replacement of the hip and knee: a standardisation analysis of UK Biobank Marcus Beasley
10:20–10:30	The effects of tourniquet use on postoperative complications after ankle fracture fixation: a multicentre comparative cohort study using propensity score weighting Muhamed Alanie
10:30–10:40	Antidepressants, Frailty, and Perioperative Opioid Consumption in Primary Total Hip Arthroplasty: A Single-Centre Cohort Study Christopher Gee
10:40–10:50	Synovial fluid biomarkers and proteomic signatures associated with clinical response to Arthrosamid® in knee osteoarthritis Karina Wright
10:50–10:55	**Sponsor presentation – A New Paradigm in Knee OA Treatment: Synovial Mechano-Modulation with Arthrosamid®** Philip Kusk PhD, Senior Project Manager, Contura
10:55–11:05	**Poster flash presentations**
11:05–11:45	**Coffee & Posters**
11:45–13:25	**Session 2: Engineering / Biomechanics** Session chair: Phil Riches
11:45–12:15	**Keynote 2: Shape Matters in Orthopaedics: Understanding Osteoarthritis Risk and Outcomes** **Dr Jenny S. Gregory, Senior Lecturer, School of Medicine, Medical Sciences and Nutrition, University of Aberdeen**
12:15–12:25	Improving trabecular microarchitecture representation in a structural whole-bone adaptation framework using a Voronoi network Muhammad Yusril Sulaiman
12:25–12:35	Comparison of markerless and marker-based motion capture accuracy benchmarked against biplane videoradiography Lauren Swain

Time	Programme
12:35–12:45	Multimodal imaging provides structural evidence for biomechanical alterations in decellularised tendon scaffolds Anthony Herbert
12:45–12:55	Gait analysis following Anterior Cruciate Ligament primary repair with Internal Bracing versus reconstruction Phil Riches
12:55–13:05	Ceramic Hip Resurfacing Maintains Physiological Femoral Bone Strain Compared with a Cemented Stem: A Biomechanical Study Milos Brkljac
13:05–13:15	Patient-specific finite element analysis of osteochondral autograft: press-fit stability and contact restoration under in vivo derived kinematics Roberto Leonardo
13:15–13:25	Characterising in-vivo lumbar disc mechanics using MRI and biplanar videoradiography David Williams
13:25–14:30	**Lunch & Posters**
14:30–15:20	**BORS Presidential Lecture: 'Futurescoping' Translational Research in Orthopaedics (from BORS Boomers to BORS Gen Z to BORS Gen Alpha)** Professor Hamish Simpson
15:20–16:00	**Coffee & Posters**
16:00–17:40	**Session 3: Clinical Technology** Session chairs: Prof Jon Clarke and Prof Christopher Gee NHS Golden Jubilee
16:00–16:30	**Keynote 3: Robotic TKA: Evolution or Revolution?** **Mr Akash Sharma, Consultant Knee Surgeon, Royal Orthopaedic Hospital, Birmingham; President, CAOS UK**
16:30–16:40	Predicting Early Aseptic Loosening in Total Knee Arthroplasty Using Longitudinal Deep Learning Rory Ormiston
16:40–16:50	Evaluating a 3D freehand ultrasound and motion capture fusion technique for patellofemoral kinematic assessment Caterina Vanelli Coralli
16:50–17:00	Evaluation of ankle joint structure in chronic ankle instability using ultrasound imaging and shear wave elastography. Kimia Rezaei Fard
17:00–17:10	Real-Time Tibial Force Sensing for Intraoperative Characterisation of Posterior Cruciate Ligament Tension in Cruciate-Retaining Total Knee Arthroplasty Alistair Lawley
17:10–17:20	Functional pelvic orientation affects acetabular assessment and clinical interpretation in structural hip disorders Mingke You
17:20–17:30	Geometric Analysis of Surface Changes in Total Ankle Replacement Polyethylene Inserts Claire Brockett
17:30–17:40	TET2 Clonal Haematopoiesis may be linked to impaired recovery following Total Hip Replacement, a multimodal analysis Ines Reichert
19:00	**BORS Bash - Conference Dinner and Welcome Drink** *University of Strathclyde Students' Union* **Dinner served from 19:30**

Day 2 — Wednesday 9th September 2026

Time	Programme
08:30–09:00	**Registration Opens**
09:00–10:40	**Session 4: Biology** Session chair: Prof Matt Dalby and Monica Tsimbouri
09:00–09:30	**Keynote 4: Biofilms at the Interface: Understanding and Tackling Infection in Orthopaedic Implants** **Prof Gordon Ramage, Professor of Infection Prevention & Control, ReaCH, Glasgow Caledonian University**
09:30–09:40	Sex Based Differences in IPSC Derived Nociceptor Responses to Osteoarthritic Synovial Fluid Ryan Jones
09:40–09:50	Type I Interferon Signalling Drives Stromal–Immune Crosstalk and Dendritic Cell Activation in Tendinopathy Clara Burgy
09:50–10:00	Unlocking the origin of Benninghoff arcades: is strain-directed alignment the architect of the stratified organisation of mature articular cartilage? Ilyas Khan
10:00–10:10	Beyond Hormonal Changes: Bone Mineral Nanostructure as a Critical Determinant of Osteogenic Impairment in Postmenopausal Osteoporosis Mostafa Khabooshani
10:10–10:20	Sex and hormonal status regulation of joint pathology, pain behaviour and DRG neuroimmune responses in early osteoarthritis Carmen Huesa
10:20–10:30	Integrated Lipidomic and Metabolomic Profiling Reveals Stage Dependent Changes and Metabolic Signatures Associated with Clinical Response Following Autologous Chondrocyte Implantation Yumna Ladha
10:30–10:40	Tissue of Origin Defines Transcriptional States in Osteoarthritis-Derived Mesenchymal Stem Cells Antonia Vogt
10:40–10:50	**Poster flash presentations**
10:50–11:35	**Coffee & Posters**
11:35–11:50	**BORS-BJR Travelling Fellowship 2027 Update** David Williams + Chloe Scott (Editor-in-Chief, Bone & Joint Research)
11:50–13:05	**Orthopaedic Cell Therapies: From GMP Manufacturing to NHS Delivery** Session chair: Jonathan Williams Sponsored by MAINSTREAM
11:50–12:05	**Navigating GMP Manufacturing in Advanced Cell Therapy Development** Dr Diana Martínez Redondo, Senior Scientist, Process Development and GMP Translation, Histocell S.L. CDMO
12:05–12:20	**Value by design in advanced therapy development** Thomas Strakosch, Health Economics and Market Access Lead, Cell and Gene Therapy Catapult
12:20–12:35	**From Vein to Vein: The NHS Cellular Therapy Pathway** Dr Samantha Carmichael MRCPharm, Lead Pharmacist, Clinical Trials / Research & Innovation / Advanced Therapy Medicinal Products Research & Innovation, NHS Greater Glasgow and Clyde
12:35–13:05	**Panel discussion and audience Q&A**

Time	Programme
13:05–14:35	**Lunch & Posters** **BORS AGM: 13:45**

Time	Programme
14:35–16:05	**Session 5: Bioengineering and Translational** Session chair: David Hamilton
14:35–15:05	**Keynote 5: Clinical Confidence from Biomechanical Modelling** **Prof Chloe Scott, Consultant Orthopaedic Surgeon, Royal Infirmary of Edinburgh, Honorary Professor, Imperial College London**
15:05–15:15	Proteomic Profiling of Osseointegration in an Ovine Femoral Condyle Model Sasza Nabilla
15:15–15:25	Impact of International Transport on Clinical Osteochondral Allograft Viability and Integrity: A Controlled Comparison Tomas Link
15:25–15:35	Cellular Response to Implant-Delivered Ultrasound Cosmo Prince
15:35–15:45	Assessing the bioactive profile of antifungal-loaded calcium sulphate against fungal biofilms Mark Craig Butcher
15:45–15:55	Cam Deformity Cartilage as a Regenerative Cell Source: Biological Characterisation and Evaluation of Arthroscopic Harvest Techniques Ben Woodhouse
15:55–16:05	Healikick: Translational development of acellular and cellular approaches to bone grafting for non-union bone repair Peter Childs
16:05–16:20	**Awards & Closing Ceremony**

Invited Speakers

BORS Presidential Lecture

Professor Hamish Simpson
Professor of Orthopaedics and Trauma, Queen Mary University of London

'Futurescoping' Translational Research in Orthopaedics
(from BORS Boomers to BORS Gen Z to BORS Gen Alpha)

Biography

Professor Hamish Simpson is an internationally renowned expert in clinical and translational research in Orthopaedic Surgery. He recently joined the Academic Centre for Healthy Ageing, Queen Mary University of London and Barts Health Trust, after holding the George Harrison Low Chair and being Head of Department of Orthopaedics & Trauma at the University of Edinburgh since 2000. Beforehand he completed his orthopaedic training and became Clinical Reader and then Professor of Orthopaedics at the University of Oxford and Fellow of St Peter's College.

Hamish Simpson has a longstanding and influential relationship with the British Orthopaedic Research Society. He became Secretary in the mid 90's and subsequently BORS President. His influence went far beyond the presidency. Hamish, combined with contemporaries at BORS and the ORS, devised the BORS Travelling Fellowship to allow international exchange between young researchers from diverse backgrounds (engineering, bioscience and clinic). The inaugural group travelled in 2007. He took over as Editor-in-Chief at the Bone & Joint Research Journal and was able to support the Travelling Fellowship with substantial funding. Many members of our BORS committees have grown out of previous Travelling Fellows.

Hamish Simpson's research interests always combined clinical questions with basic science methodologies, and he gathered an impressive range of expertise, being able to converse with scientists as well as clinicians. He took on several honorary positions advancing the interests of translational orthopaedic research, including previous BOA Research Committee Lead, ORS ISFR International Fracture Society Immediate Past President and ongoing, ICORS President.

Keynote Speaker

Professor Neal Millar

Translational orthopaedics ...are we there yet ??

Professor of Orthopaedics, University of Glasgow
Academic Consultant Orthopaedic Surgeon, Queen Elizabeth University Hospital

About the speaker

Professor Millar is a Professor of Orthopaedics at the University of Glasgow and an academic shoulder surgeon at Queen Elizabeth University Hospital in Glasgow, specialising in shoulder surgery having completed shoulder fellowships in Sydney (Prof George Murrell) and New York. (Dr Evan Flatow) He runs a basic science lab investigating the molecular pathophysiology of tendinopathy; an overuse injury, characterised by tendon pain and weakness with a significant burden of disease. Professor Millar is recognised as an international expert on treating patients with tendon problems and has extensive experience in working within multidisciplinary environments with physiotherapists, rheumatologists, coaches, and sports therapists and his aim is to help every patient achieve their maximum potential.

Professor Millar's specialist interests include the treatment of rotator cuff problems, instability, arthritis and stiffness of the shoulder. He is an expert in fluoroquinolone (FQ) related musculoskeletal toxicity/disability having sat on the European Medicines Agency panel on fluoroquinolone toxicity. He sees many UK/EU/US FQ patients both in his NHS and private practice. Additionally, he runs a specialist 'One stop' complex tendon clinic in the NHS focused on improving the treatment of tendinopathy.

Keynote Speaker

Dr Jenny S. Gregory

Shape Matters in Orthopaedics: Understanding Osteoarthritis Risk and Outcomes

Senior Lecturer, School of Medicine, Medical Sciences and Nutrition, University of Aberdeen

About the speaker

Dr Jenny Gregory is a Senior Lecturer in the School of Medicine, Medical Sciences and Nutrition at the University of Aberdeen, where she leads the Sports and Exercise Science degree programmes. Her research focuses on the application of advanced medical image analysis techniques to understand musculoskeletal health, disease and ageing, with expertise in bone morphology, osteoarthritis and physical activity.

Dr Gregory is internationally recognised for her work in statistical shape modelling (SSM), a powerful approach for quantifying anatomical variation and identifying clinically relevant patterns of musculoskeletal disease. Her research has utilised large imaging datasets, including UK Biobank, to investigate the relationships between bone shape, osteoarthritis, fracture risk and functional outcomes. Through the integration of imaging, biomechanics and data science, she has helped advance understanding of how skeletal morphology changes across the lifespan and in response to disease.

Jenny's work spans a range of imaging modalities, including radiography, DXA, MRI and CT, and has contributed to the development of imaging biomarkers and their links to diagnosis, risk prediction and evaluation of treatment.

Keynote Speaker

Mr Akash Sharma

Robotic TKA: Evolution or Revolution?

Consultant Knee Surgeon, Royal Orthopaedic Hospital, Birmingham; President, CAOS UK

About the speaker

Mr Akash Sharma is a Consultant Knee Surgeon at the Royal Orthopaedic Hospital, Birmingham, and President of CAOS UK. He specialises in robotic-assisted knee replacement, partial knee replacement, ligament reconstruction, and complex revision surgery. After graduating with Distinction from St George's, London, he completed specialist training in London, Oxford, and Birmingham, followed by fellowships in Oxford and Nottingham. His work focuses on precision surgery, digital innovation, and improving outcomes through computer-assisted techniques. As CAOS UK President, he leads national efforts to advance education, research, and safe adoption of emerging orthopaedic technologies

Keynote Speaker

Professor Gordon Ramage

Biofilms at the Interface: Understanding and Tackling Infection in Orthopaedic Implants

Professor of Infection Prevention & Control, ReaCH, Glasgow Caledonian University

About the speaker

Gordon Ramage is Professor of Infection Prevention and Control and Director of the Research Centre for Health (ReaCH) within the School of Health and Life Sciences at Glasgow Caledonian University. He trained at the University of Edinburgh, Queen's University Belfast, the University of Texas Health Science Center at San Antonio, the University of Calgary and the University of Glasgow, where he was awarded a Personal Chair in 2012. His PhD at Queen's University Belfast focused on prosthetic joint infection, establishing an early interest in biofilm-associated infections.

An internationally recognised microbiologist, Gordon has spent over 30 years investigating the role of microbial biofilms in infection, with pioneering contributions to understanding fungal biofilms, particularly those formed by *Candida* species. His research now spans fungal and bacterial biofilms, polymicrobial and interkingdom interactions, antimicrobial resistance, infection prevention and control, and the development of novel diagnostics and therapeutics. His work has advanced understanding of biofilm-associated infections affecting medical devices, wounds, the oral cavity and healthcare environments, including emerging pathogens such as *Candidozyma auris*. More recently, his research has expanded into oral microbiome science, chronic wounds, diabetic foot disease, biomaterials and biofilm-targeted therapeutics through close clinical and industry collaborations.

Gordon is a Fellow of the Royal Society of Biology, the European Society for Clinical Microbiology and Infectious Diseases, the European Confederation of Medical Mycology, and an Honorary Member of the British Society for Medical Mycology.

Keynote Speaker

Professor Chloe Scott

Clinical Confidence from Biomechanical Modelling

Consultant Orthopaedic Surgeon, Royal Infirmary of Edinburgh; Honorary Professor, Imperial College London

About the speaker

Professor Chloe Scott is a consultant hip, knee & trauma surgeon at the Royal Infirmary of Edinburgh and is Editor-in-Chief of Bone and Joint Research. Clinically she has specialist interests in complex knee arthroplasty surgery and periprosthetic fracture management. Her research interests include arthroplasty outcomes, periprosthetic fractures, robotic surgery, finite element analysis and knee biomechanics in which she has over 140 publications. She is an Honorary Professor of Mechanical Engineering at Imperial College London where she works with industry partners and academics in knee replacement implant design. She was awarded the Hunter Doig medal by the Royal College of Surgeons of Edinburgh in 2020 and was featured in their portrait “Eleven Surgeons” in 2025. She is an advocate for diversity in surgery and is involved in diversity projects both in the UK and America and is a member of Pride Ortho.

Orthopaedic Cell Therapies: From GMP Manufacturing to NHS Delivery

Sponsored by MAINSTREAM
Session Chair: Jonathan Williams

This special session explores the translational pathway for orthopaedic cell therapies, from GMP manufacturing and process development through health economics and market access to delivery within the NHS. The session brings together perspectives from industry, the Cell and Gene Therapy Catapult and NHS clinical services, followed by a panel discussion and audience Q&A.

Dr Diana Martínez Redondo

Navigating GMP Manufacturing in Advanced Cell Therapy Development

Senior Scientist, Process Development and GMP Translation, Histocell S.L. CDMO

Diana will focus on cell manufacturing and the translation of cell therapies into GMP-compliant processes within a CDMO setting. Her presentation will cover core GMP concepts, operational considerations and quality systems supporting the manufacture of clinical-grade cell therapy products.

Tom Strakosch, MSc

Value by design in advanced therapy development

Health Economics and Market Access Lead, Cell and Gene Therapy Catapult

Tom will discuss how market access considerations can be incorporated into therapy development from the early stages to improve the chances of commercial success, including a worked example of health technology assessment in an orthopaedic cell therapy.

Tom Strakosch is a Health Economics and Market Access Lead at Cell and Gene Therapy Catapult. He specialises in market access strategy, health technology appraisal decision making, and economic modelling for the development of Advanced Therapy Medicinal Products (ATMPs).

Samantha Carmichael

From Vein to Vein: The NHS Cellular Therapy Pathway

Lead Pharmacist for Clinical Trials, Research & Innovation and Advanced Therapy Medicinal Products, NHS Greater Glasgow & Clyde

Samantha leads pharmacy activity supporting clinical trials, research and innovation, and advanced therapy medicinal products across NHS Greater Glasgow & Clyde. Her experience includes the development, regulatory oversight and delivery of cell and gene therapies, including first-in-human gene therapy studies, academic and commercial ATMP trials, and licensed cellular therapies. She is also involved in national ATMP networks supporting the adoption and expansion of innovative cellular and gene therapies across Scotland.

BORS-BJR Travelling Fellowship

A **BORS–BJR Travelling Fellowship 2027 Update** will be presented by David Williams and Professor Chloe Scott at 11:35 on Day 2.

The Travelling Fellowship supports early-career researchers and clinicians to engage with world leading orthopaedic research communities, develop international collaborations, and represent British orthopaedic research within the wider musculoskeletal research community.

The next fellowship cycle will align with European Orthopaedic Research Society Congress 2027 and will provide selected fellows with the opportunity to attend and contribute to one of Europe's leading orthopaedic research meetings.

Eligibility Criteria

Applicants should:

- Be a current BORS member in good standing
- Have held BORS membership for a minimum of two years
- Have previously presented at a BORS Annual Meeting
- Be engaged in orthopaedic or musculoskeletal research
- Demonstrate a strong interest in collaborative and translational research

Oral Presentation Abstract

Session 1 – Clinical Orthopaedics

Inequalities in the use of total hip replacement to treat hip fracture: a population-based study

James Webster[1], Antony Johansen[2], Xavier Griffin[3], Eva Morris[1], Sasha Shepperd[1], Raphael Goldacre[1]

[1]Applied Health Research Unit, Nuffield Department of Population Health, University of Oxford, Oxford, United Kingdom. [2]University Hospital of Wales and School of Medicine, Cardiff University, Cardiff, United Kingdom. [3]Bone and Joint Health, Queen Mary University London, London, United Kingdom

Abstract

Research question: Displaced intracapsular hip fractures are treated with total hip replacement (THR) or hemiarthroplasty. THR is recommended for patients who are fit for surgery, have normal cognitive function, and were independently mobile pre-fracture. We investigated socio-economic and hospital-level variation in THR use to treat hip fracture across England.

Methods: A population-based study was conducted using data from the National Hip Fracture Database (NHFD) (April 2011–June 2025). Adults aged ≥60 years with a hip fracture who fulfilled national guidelines for THR and received arthroplasty were included. Variation in THR use was explored by quintiles of the Index of Multiple Deprivation (IMD) and between hospitals using logistic regression models overall and by study period (2011-2016, 2017-2022, and 2023-2025). All models adjusted for patient-level demographic and clinical characteristics.

Results: Among 144,192 THR-eligible patients, casemix-adjusted THR rates were significantly lower in the most versus least deprived quintile. This gap was wider in 2023–2025 (OR 0.59, 95% CI 0.53 to 0.66; absolute THR % difference: 9.6%, 95% CI: 11.0% to 8.0%) than in earlier periods (p–interaction<0.0001). Large between-hospital differences in THR use were observed. From 2023–2025, across 134 hospitals, the casemix-adjusted THR rate ranged from 0.6% to 49.2%. There was slightly less variation in later years than earlier years [adjusted mean THR rate 22.1% (SD 9.2%) in 2023–2025; 30.0% (9.5%) in 2017–2022; and 27.4% (11.3%) in 2011–2016; Levene's test of variances p=0.03].

Conclusions: The use of THR to treat hip fracture where recommended is low, and varies widely by area-based deprivation and the treating hospital. These inequalities have remained wide over the past decade. Further research is needed to understand the consequences of these inequalities on patient outcomes, and to determine if differences in hospital resources, surgeon preferences, residual patient casemix, or other factors are driving inequalities.

Declaration of Interest

(b) declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported:I declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research project.

The gut microbiome as a reservoir of pathogens and antimicrobial resistance in orthopaedic infection

Christopher Deacon[1,2], Afroditi Kouraki[3], Neel Badhe[4], Haseeb Khawar[3], Jessica Nightingale[3], Ben Marson[3], Benjamin Ollivere[3], Ana Valdes[3]

[1]Injury, Recovery & Inflammation Sciences, School of Medicine, University of Nottingham, Nottingham, United Kingdom. [2]NIHR Nottingham Biomedical Research Centre, Queens Medical Centre, Nottingham, United Kingdom. [3]University of Nottingham, Nottingham, United Kingdom. [4]University of Cambridge, Cambridge, United Kingdom

Abstract

Research Question: The origin of organisms causing orthopaedic infection remains incompletely understood. The gut microbiome represents a potential endogenous reservoir of pathogens and antimicrobial resistance genes (ARGs). This study evaluated overlap between gut microbiome taxa and orthopaedic infection isolates and compared ARG prevalence between these environments.

Methods: A prospective pilot cohort of 21 patients undergoing hip fracture surgery provided stool samples for shotgun metagenomic sequencing. Microbial taxonomic composition was assessed at genus level and ARGs identified by alignment to the ResFinder database. These findings were compared with microbiological results from deep tissue culture in a retrospective cohort of 166 patients undergoing 266 procedures for orthopaedic infection (fracture-related or prosthetic joint infection). The association between gut-associated organisms and polymicrobial infection was assessed using Fisher's exact test.

Results: Of 266 procedures, 190 were culture-positive on deep tissue sampling and included in the analysis. Gut-associated organisms were identified in 87/190 (45.8%) procedures. A strong association was observed between gut-associated organisms and polymicrobial infection: 68/92 (73.9%) polymicrobial procedures contained gut-associated organisms compared to 19/98 (19.4%) monomicrobial procedures ($p<0.001$; OR 11.6, 95% CI 5.7–24.8). Several genera prevalent in orthopaedic infections were also highly prevalent in the gut microbiome, including Streptococcus (100%), Escherichia (95%), Bacteroides (95%), and Clostridium (95%). Resistance determinants for macrolide-lincosamide-streptogramin antibiotics and tetracyclines were significantly more prevalent in gut microbiome samples than in orthopaedic infection datasets (erm(B) 86.4% vs 3.8%, $p<0.001$; tet(M) 72.7% vs 3.8%, $p<0.001$). In contrast, resistance genes associated with staphylococcal infection were more commonly identified in infection isolates.

Conclusions: There is substantial overlap between gut microbiome taxa and bacteria isolated from orthopaedic infections, supporting the hypothesis of an endogenous reservoir. The high prevalence of ARGs within the gut may influence infection behaviour under selective antibiotic pressure, warranting investigation of perioperative microbiome optimisation strategies to reduce infection risk.

Declaration of Interest

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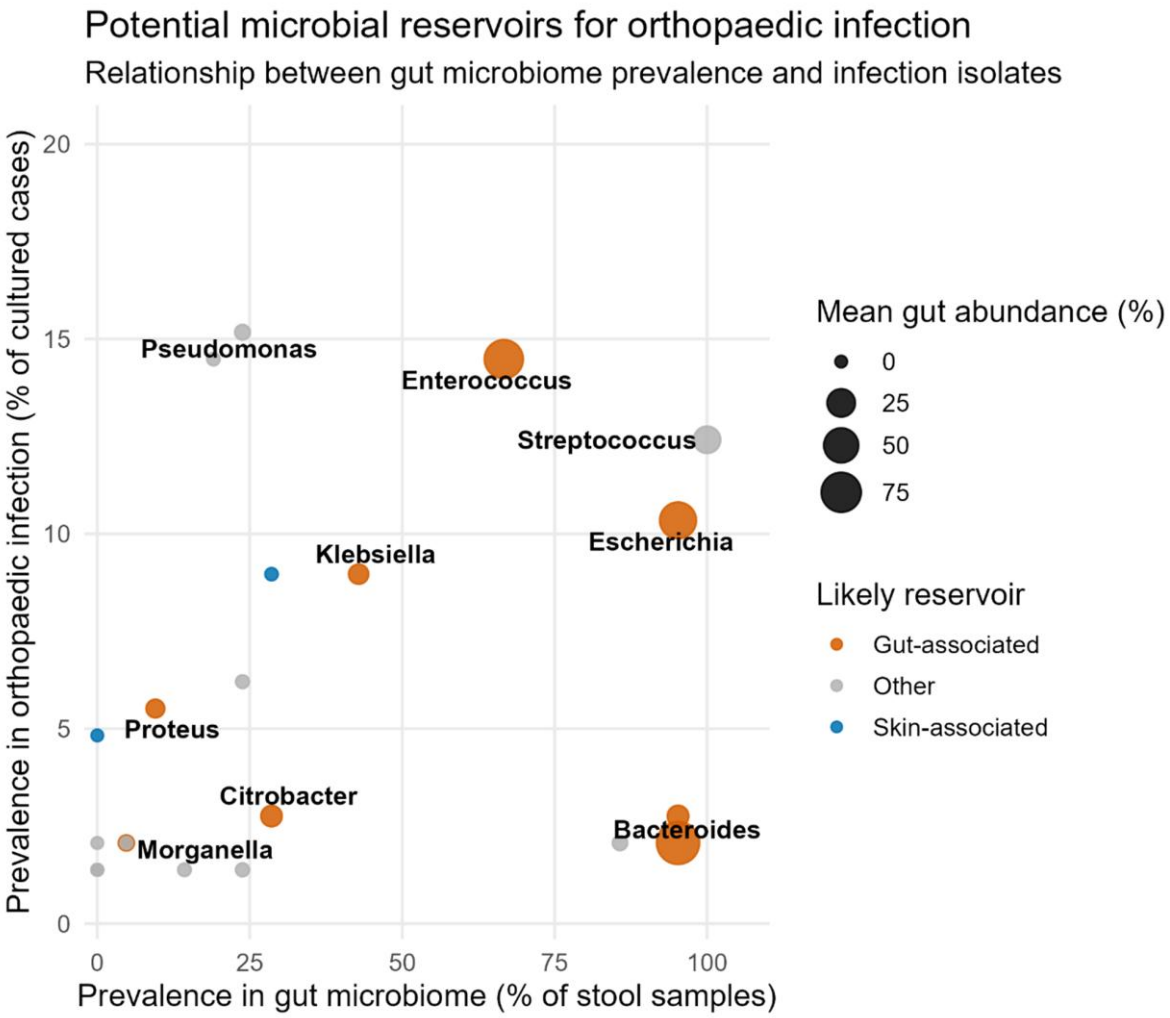
Potential microbial reservoirs for orthopaedic infection
Relationship between gut microbiome prevalence and infection isolates
Prevalence in orthopaedic infection (% of cultured cases)
Prevalence in gut microbiome (% of stool samples)
0
5
10
15
20
0
25
50
75
100
Pseudomonas
Enterococcus
Streptococcus
Escherichia
Klebsiella
Proteus
Citrobacter
Morganella
Bacteroides
Mean gut abundance (%)
0
25
50
75
Likely reservoir
Gut-associated
Other
Skin-associated

Patient-Specific Periprosthetic Fracture Risk Calculator in Total Hip Arthroplasty: A Multicenter Update

Milos Brkljac[1], Joe Panos[2], Dirk Larson[3], Joshua Bingham[4], Bryan Springer[5], Rafael Sierra[2], Michael Taunton[2], Matthew Abdel[2], Cody Wyles[2]

[1]Imperial College London, London, United Kingdom. [2]Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN, USA. [3]Department of Quantitative Health Sciences, Mayo Clinic, Rochester, MN, USA. [4]Department of Orthopedic Surgery, Mayo Clinic, Phoenix, AZ, USA. [5]Department of Orthopedic Surgery, Mayo Clinic, Jacksonville, FL, USA

Abstract

Research Question: Periprosthetic femoral fracture (PPFFx) after total hip arthroplasty (THA) is a serious complication influenced by both patient factors and modifiable surgical factors. A previously developed patient-specific risk calculator demonstrated wide variability in risk and the potential for intraoperative modification. This study aimed to validate, expand and refine this model using a large multicenter THA cohort.

Methods: We evaluated 25,510 primary THAs performed between 2000 and 2024 across three centers. Patients were characterized by nonmodifiable factors including age, sex, indication for THA, and osteoporosis, as well as modifiable operative variables including surgical approach, femoral fixation (cemented/cementless), and collar use. Multivariable Cox regression models and nomograms were developed to estimate PPFFx risk at 90 days, 1 year, and 5 years postoperatively.

Results: Predicted patient-specific PPFFx absolute risk ranged from 0.4% to 13.7% at 90 days and 0.6% to 19.2% at 5 years, varying by patient profile and operative factors. Using posterior, collarless, uncemented constructs as the reference (HR 1.0), direct anterior constructs were associated with lower relative risk (HR 0.6–0.7), while lateral constructs showed variable risk (HR 0.5–1.5) depending on fixation and collar use. Collar use (HR 0.7, 95% CI: 0.6 – 0.9) and cemented fixation (HR 0.5, 95% CI: 0.4 – 0.7) were each independently associated with reduced risk of PPFFx.

Conclusion: This multicenter analysis demonstrates that PPFFx risk varies widely across patients with differing nonmodifiable risk profiles and can be meaningfully influenced by surgeon decision-making. Surgical approach, fixation, and collar use each demonstrated significant impact on fracture risk, with interdependence of final risk based on the combination used. These findings support patient-specific operative planning to mitigate fracture risk.

Declaration of Interest

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Population-level associations of BMI and physical activity with chronic pain, osteoarthritis, and joint replacement of the hip and knee: a standardisation analysis of UK Biobank

Marcus Beasley[1], Jennifer Summers[1], Luke Farrow[1,2], Stephen Bridgman[1,3], Gary Macfarlane[1]

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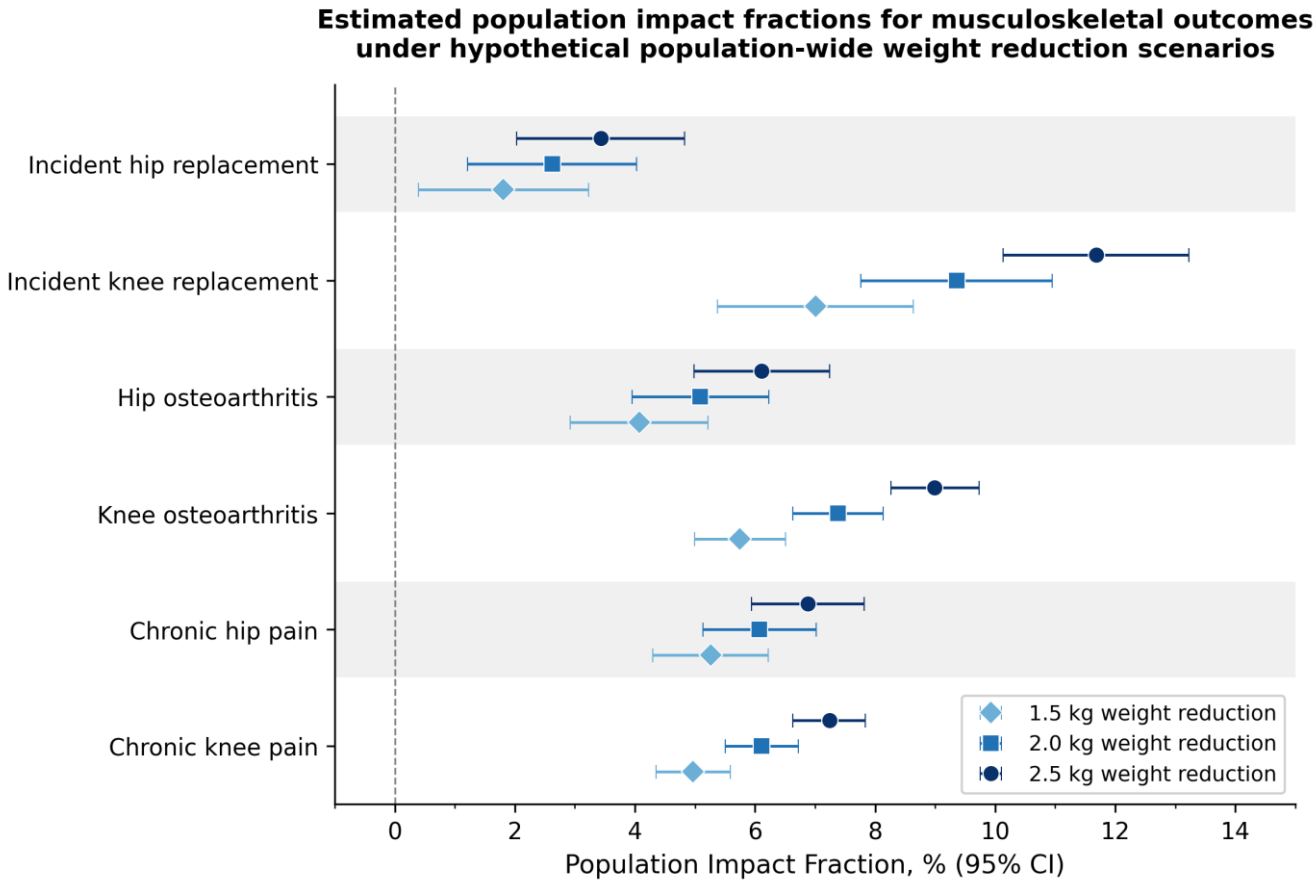
Abstract

RESEARCH QUESTION Demand for hip and knee replacement is projected to rise in the coming years, and clinical services are unlikely to meet it. Population-level prevention can complement surgical provision, but the potential scale of benefit from changes in known risk factors has not been quantified in absolute terms. This study estimated the proportion of musculoskeletal disease burden associated with BMI and physical activity across the population.

METHODS We used UK Biobank, a cohort of over 500,000 adults aged between 40 and 69 years at recruitment, to examine six musculoskeletal outcomes: chronic knee and hip pain, knee and hip osteoarthritis, and incident primary knee and hip replacement. Model-based standardisation (g-computation) was used to estimate population impact fractions, the estimated proportional reduction in prevalence or incidence if the entire population's exposure distribution were shifted by a specified amount. Scenarios modelled uniform population-wide reductions in body weight (1.5, 2.0, and 2.5 kg) and an increase in moderate physical activity (+73 minutes/week), with magnitudes informed by systematic reviews of behavioural interventions.

RESULTS BMI showed consistent, dose-dependent associations with all six outcomes. A population-wide weight reduction of 2.5 kg was associated with population impact fractions of 7.2% for chronic knee pain, 9.0% for knee osteoarthritis, and 11.7% for incident knee replacement. Associations were smaller for hip outcomes, particularly hip replacement (3.4%). Physical activity showed no clear association with any outcome.

CONCLUSIONS Modest, population-wide weight reductions were associated with important reductions in the burden of chronic pain, osteoarthritis, and joint replacement, particularly at the knee. These findings support the case for population-level weight reduction interventions and strategies to help manage rising demand for orthopaedic services associated with an ageing population.



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The effects of tourniquet use on postoperative complications after ankle fracture fixation: a multicentre comparative cohort study using propensity score weighting

Muhamed Farhan-Alanie

University of Warwick, Coventry, United Kingdom

Abstract

RESEARCH QUESTION: To evaluate whether tourniquet use during ORIF of closed ankle fractures is associated with surgical site infection, venous thromboembolism, length of stay, and re-operation.

METHODS: We carried out a retrospective multicentre cohort study across nine hospitals, including patients aged 18 years or older who underwent open reduction and internal fixation for an isolated, closed OTA/AO type 44B or 44C ankle fracture. Primary outcome was reoperation for all-causes. Secondary outcomes were superficial and deep surgical site infection (SSI), reoperation for infection, deep vein thrombosis (DVT) and pulmonary embolism (PE) within 90 days post-operatively, and length of stay. Propensity score based inverse probability weighting was employed, with Cox regression for reoperation outcomes, logistic regression for binary outcomes, and linear regression for length of stay. Association between tourniquet duration and risk of superficial and deep SSI was also evaluated.

RESULTS: 3,239 procedures among 3,233 patients were included, of which 2,438 (75.3%) were performed with and 801 (24.7%) without tourniquet. Mean age was 47.9 and 50.0 years, with 58.0% and 57.6% females in the tourniquet and non-tourniquet groups, respectively. Tourniquet use was not associated with reoperation for all-causes (HR 0.92, 95%CI 0.67-1.26, p=0.588), reoperation for infection (HR 1.19, 95%CI 0.64-2.19, p=0.585), superficial SSI (OR 0.84, 95%CI 0.58-1.21, p=0.358), deep SSI (OR 1.45, 95%CI 0.80-2.65, p=0.220), DVT (OR 1.10, 95%CI 0.30-4.01, p=0.889), PE (OR 1.07, 95%CI 0.34-3.37, p=0.913), or length of stay (coefficient 0.33 days, 95%CI −0.09-0.73, p=0.124). Longer tourniquet duration was associated with increased odds of superficial SSI (OR 1.35, 95% CI 1.07 to 1.72, p=0.010). Association between tourniquet duration and deep SSI was inconsistent between different modelling approaches.

CONCLUSIONS: Tourniquet use was not associated with differences in reoperation, infection, venous thromboembolism, or length of stay. Longer inflation time may increase superficial SSI risk, therefore this duration should be minimised where possible.

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Antidepressants, Frailty, and Perioperative Opioid Consumption in Primary Total Hip Arthroplasty: A Single-Centre Cohort Study

Swati Chopra, Conor McCann, Gabriele Lindhoff, Carrie Dunsmuir, Nicholas Holloway, Christopher Gee, Jon Clarke

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Abstract

RESEARCH QUESTION: Does preoperative antidepressant (AD) use independently predict functional recovery following primary total hip arthroplasty (THA), and does perioperative opioid consumption differ by AD class in a secondary analysis?

METHODS: Retrospective cohort study of 1,394 consecutive primary THA patients (367 AD users, 1,027 non-users) at a high-volume arthroplasty centre. The primary outcome was 12-month Oxford Hip Score (OHS) analysed using mixed-effects models adjusted for comorbidity burden, Clinical Frailty Scale (CFS), and baseline PROMs. Secondary outcomes included EQ-5D Health Index (HI), perioperative opioid consumption, patient acceptable symptom state (PASS) achievement, and complications. Pre-specified subgroup analysis compared Tricyclic AD (TCA) and Selective Serotonin Reuptake Inhibitors (SSRI) / Serotonin-Norepinephrine Reuptake Inhibitors (SNRI) users.

RESULTS: AD users had significantly higher comorbidity burden, frailty, preoperative opioid use, and lower baseline PROMs. At 12 months, OHS did not differ between groups after full adjustment (p = 0.85). The EQ-5D HI interaction favoured the AD group, indicating proportionally greater quality-of-life improvement from baseline. PASS achievement was lower in AD users across all measures at both timepoints, consistent with lower baseline scores rather than inferior recovery trajectories. AD users consumed approximately 50% more inpatient opioid (20.4 vs. 13.6 mg oral morphine equivalents, p < 0.001), independent of frailty and preoperative opioid status. TCA users consumed significantly less opioid than SSRI/SNRI users (17.1 vs. 23.6 mg, p = 0.001) and had shorter hospital stay (1.78 vs. 2.24 days, p < 0.001). Approximately 70% of TCA users had no documented psychiatric diagnosis, suggesting pain-indication prescribing. The composite complication rate did not differ between groups (3.5% vs. 5.8%, p = 0.10).

CONCLUSIONS: AD use does not compromise 12-month functional recovery following THA. However, AD users require substantially more perioperative opioid, and TCA users consume significantly less than SSRI/SNRI users. Recognising AD class at preoperative assessment may allow targeted perioperative analgesic planning

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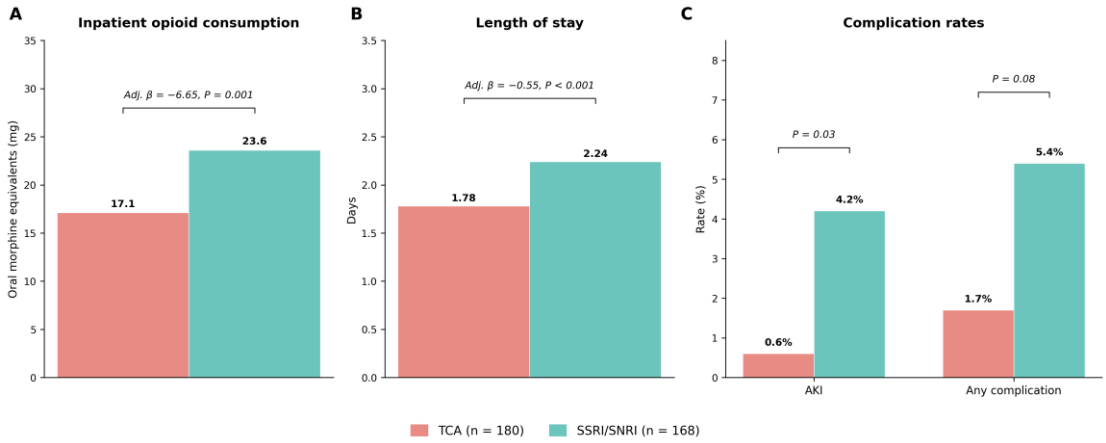

Synovial fluid biomarkers and proteomic signatures associated with clinical response to Arthrosamid® in knee osteoarthritis

Sharon Owen[1,2], Larissa Rix[1,2], Emily-Jayne Clarke[3], Bernhard Tins[2], Alexander Glover[2], Richard Roach[2], Paul Jermin[2], Mandy Peffers[3], Karina Wright[1,2], Martyn Snow[4,1]

[1]Keele University, Keele, United Kingdom. [2]RJAH Orthopaedic Hospital, Oswestry, United Kingdom. [3]Liverpool University, Liverpool, United Kingdom. [4]The Royal Orthopaedic Hospital, Birmingham, United Kingdom

Abstract

Research Question: To investigate synovial fluid (SF) biomarkers and proteomic signatures associated with clinical response following intra-articular Arthrosamid® (polyacrylamide hydrogel) injection in knee osteoarthritis (OA) and to identify biological predictors of 12-month outcome.

Methods: This prospective observational study included adults with symptomatic radiographic knee OA treated with a single 6 ml Arthrosamid® injection. Clinical outcomes (VAS, KOOS, WOMAC) were recorded at baseline, 3, 6 and 12 months. SF was aspirated at baseline and 3 months for targeted biomarker analysis (IL-6, IL-1ra, sCD14, ADAMTS-4, MMP3, HA, PRG4) and untargeted label-free mass spectrometry. Responders were defined by ≥10-point improvement in WOMAC at 12 months. Bioinformatic and longitudinal statistical analyses were performed.

Results: Sixty-two knees completed follow-up; 41 (66%) were responders and 18 (29%) non-responders. Responders demonstrated sustained improvement in pain and function, while higher baseline Kellgren–Lawrence grade was associated with non-response. At 3 months, IL-1ra was increased in responders and non-responders whilst sCD14 was higher in responders with non-responders demonstrating increased catabolic activity (higher levels of ADAMTS-4 and MMP3). Better function and lower radiographic severity with higher ADAMTS-4 and MMP3 levels at baseline predicted better 12-month outcomes. Worse 12-month outcomes were associated with being female and continued ADAMTS-4 and MMP3 elevation at 3 months. Mass spectrometry revealed minimal proteomic change in responders but activated inflammation and matrix remodelling in non-responders with macrophage markers, complement and proteasome/chaperone proteins being key.

Conclusion: Arthrosamid®'s mode of action from immunohistochemical evidence suggests it becomes structurally incorporated into synovial tissue, potentially altering its biomechanical properties and providing a temporary barrier to the inflammatory crosstalk in OA tissues. This study found a good clinical response to Arthrosamid® with distinct biological phenotypes reflecting responders/non-responders. Further validation in controlled trials is required to ensure optimal patient selection for improved Arthrosamid® clinical efficacy and healthcare resource utilisation.

Declaration of Interest

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Session 2 – Engineering / Biomechanics

Improving trabecular microarchitecture representation in a structural whole-bone adaptation framework using a Voronoi network

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Abstract

INTRODUCTION: Structural finite element (FE) frameworks for bone adaptation offer a promising means of assessing whole-bone biomechanical behaviour, capturing both macro- and microscale mechanics at resolutions comparable to micro-computed tomography, with high computational efficiency compared to continuum approaches. A structural framework that uses a high-connectivity truss (HCT) network and shell elements to represent trabecular and cortical bone, respectively, with a strain-driven bone adaptation algorithm has successfully predicted trabecular trajectories using loading from daily activities, and fracture loads and patterns in the femur. However, trabecular bone consists of a bending-dominated, low-connectivity network, in contrast to the stretch-dominated, high-connectivity network used in the existing structural framework, limiting its physiological fidelity at the microscale.

METHODS: The present study used a Voronoi network to model trabecular bone layout within a structural FE framework, with shell and beam elements representing the cortical layer and trabeculae, respectively. The strain-driven adaptation algorithm was applied to a femur with both Voronoi and HCT networks under musculoskeletal-derived physiological loading in two scenarios: (1) five daily activities (VB1 and HCT1); and (2) walking only (VB2 and HCT2), representing reduced physical activity. The five activities considered were walking, stair ascent, stair descent, sit-to-stand, and stand-to-sit.

RESULTS: All models successfully predicted the five main trabecular trajectories and whole-bone axial and bending stiffnesses comparable to those of cadaver bones, with the Voronoi models providing a more physiological microscale representation. As expected under reduced physical activity, VB2 showed the most pronounced trajectories, while HCT2 remained similar to HCT1.

CONCLUSIONS: The Voronoi model is more sensitive to the loading regime than the HCT, improving the framework's ability to predict the effects of exercise variation and the development of osteopenia. More broadly, this advancement is valuable in applications that require detailed trabecular mechanics, such as in skeletal conditions (osteoporosis and osteoarthritis) assessment and orthopaedic implant development.

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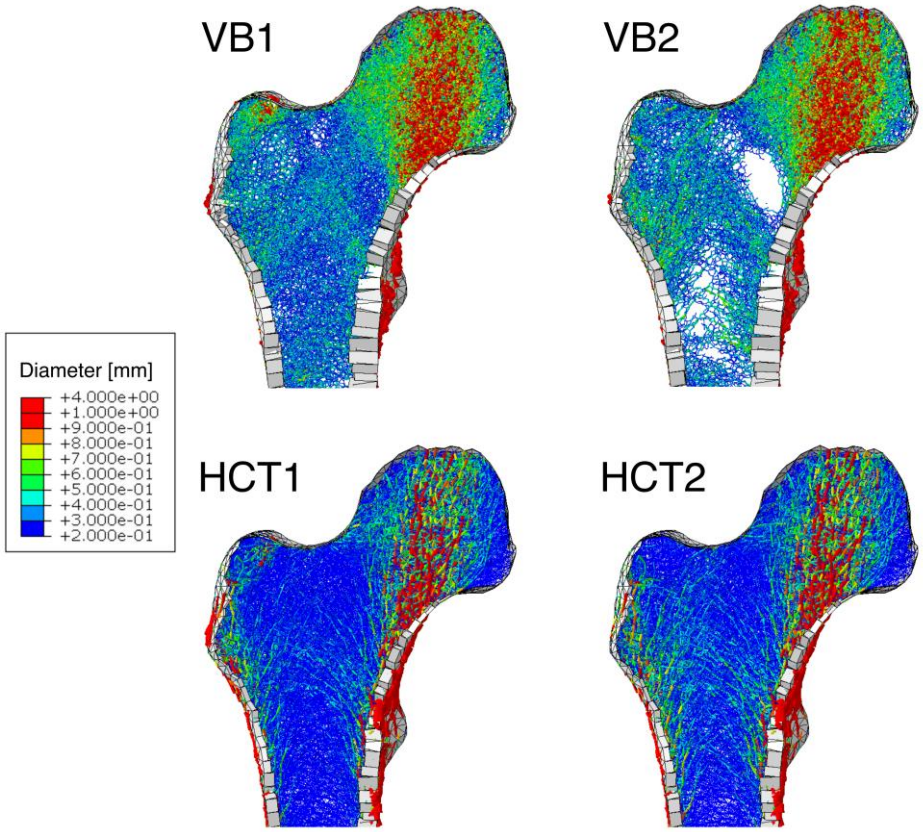

Figure S1. Coronal 10 mm slice through each converged model (VB - Voronoi beam, HCT - high-connectivity truss), coloured by strut diameter (mm). Reduced activity produces more pronounced trajectories in both frameworks (VB2 and HCT2), while VB appears to be more sensitive to the loading regime. Despite visibly different architectures, total bone volume reduction is comparable: 22.5% (HCT) vs 21.1% (VB).

Comparison of markerless and marker-based motion capture accuracy benchmarked against biplane videoradiography

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Abstract

RESEARCH QUESTION: Markerless motion capture is an emerging technique for human motion analysis that eliminates the need for marker placement, but its accuracy has primarily been evaluated against marker-based motion capture rather than gold-standard biplane videoradiography (BVR). How do markerless and marker-based motion capture compare for calculating knee rotations during gait when benchmarked against BVR?

METHODS: Synchronous marker-based motion capture, video footage, and BVR were recorded while five healthy volunteers (3M/2F) walked on a treadmill declined at 5°. Marker trajectories were tracked in QTM (Qualysis) and knee rotations calculated in Visual3D (HAS motion). Whole-body kinematics were calculated from video footage in Theia3D (Theia). Bone models segmented from MRI (Simpleware, ScanIP) were registered to pairs of X-rays (SlicerAutoscoperM[1]) at each frame. Anatomical coordinate systems were applied to the bone models[2] and BVR knee rotations were calculated (MATLAB, Mathworks) using the joint coordinate system approach[3]. All rotations were using a 6 Hz low-pass Butterworth filter. Root mean squared error (RMSE) was calculated between each motion capture technique and BVR.

RESULTS: Both motion capture techniques generally overestimated knee flexion relative to BVR, although marker-based motion capture produced lower flexion RMSE than markerless motion capture (8.2° vs 11.4°). Adduction accuracy was comparable between techniques, with slightly lower RMSE for markerless motion capture (3.7° vs 4.0°). Internal rotation demonstrated the largest discrepancies, particularly for markerless motion capture (10.5° vs 6.0°), with errors reaching 18.4° in one participant.

CONCLUSIONS: Markerless motion capture demonstrated comparable accuracy to marker-based motion capture for knee flexion and adduction during gait relative to gold-standard BVR. However, substantially larger errors in internal rotation suggest caution when using current markerless approaches for applications requiring accurate transverse plane knee kinematics.

REFERENCES: [1]Morton et al., J Biomechanics, 2025 [2]Miranda et al., J Biomechanics, 2010 [3]Grood and Suntay, J Biomechanical Engineering, 1983

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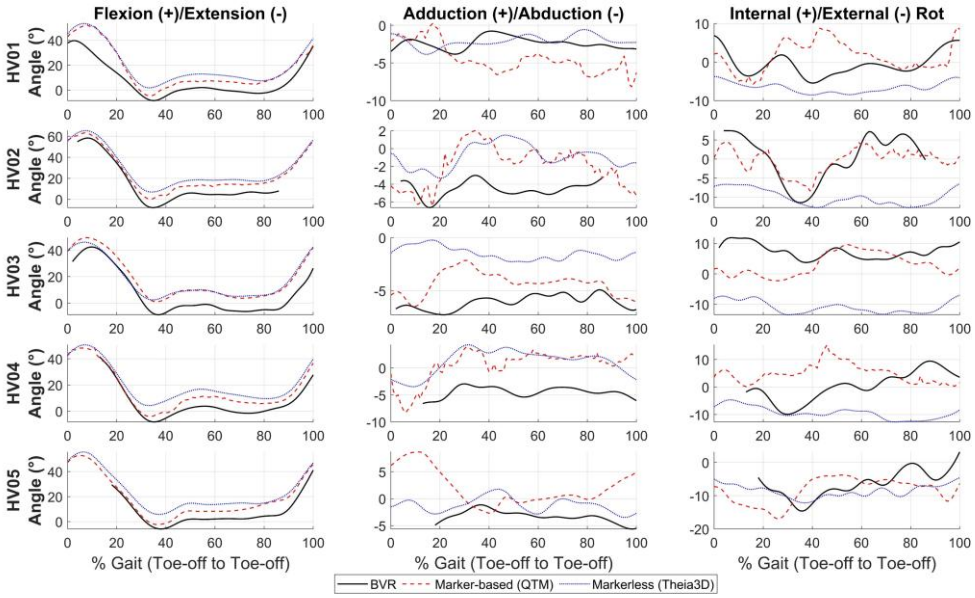

FIG. 1 – The three tibiofemoral rotations plotted against percentage gait cycle during decline treadmill walking for the five participants to compare markerless and marker-based motion capture outputs with gold-standard BVR kinematics.

Multimodal imaging provides structural evidence for biomechanical alterations in decellularised tendon scaffolds

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Abstract

Research Question: Understanding how extracellular matrix structure and composition governs mechanical function is critical for development and evaluation of tendon biological scaffolds. Here, we investigate whether multimodal nonlinear imaging can identify decellularisation-induced microstructural and compositional changes that underpin previously reported alterations in biomechanical performance. We employed a multimodal imaging framework integrating stimulated Raman scattering (SRS), second harmonic generation (SHG), and scanning electron microscopy (SEM) to assess structural and compositional differences between native and decellularised porcine tendon produced using established 26-day and novel 4-day protocols [1].

Methods: Three tendon groups (native, 4-day decellularised, and 26-day decellularised; n=3/group) were imaged hydrated in phosphate-buffered saline using a Stellaris 8 microscope with multimodal nonlinear imaging capabilities. One sample from each group was additionally analysed using a Tescan AmberX Plasma FIBSEM following cryofracture, freeze-drying, and carbon coating.

Results: SHG imaging revealed progressive disruption of collagen organisation following decellularisation, including reduced fibril definition, smoothing of collagen crimp, and decreased hierarchical organisation, with these changes most pronounced in the 26-day group. SRS imaging at 2935 cm^{-1} and 2850 cm^{-1} demonstrated alterations in protein and lipid distributions respectively, with native tendon exhibiting stronger lipid-associated signal relative to decellularised groups. Raman spectral analysis of the CH-stretching region further demonstrated compositional differences between native and decellularised tendon, while revealing similar biochemical profiles between the 4-day and 26-day protocols despite their differing structural outcomes. SEM further demonstrated fibrillar disorganisation and surface irregularities following prolonged processing.

Conclusions: These imaging findings corroborate previously published biomechanical data demonstrating that extended decellularisation is associated with reductions in tensile properties and viscoelastic performance [1]. Collectively, the findings demonstrate that the shorter, less aggressive decellularisation protocol better preserves native tendon structure-function relationships, supporting its use in the production of biological scaffolds for regenerative implants and in vitro disease models.

References: 1. Haines et al., 2026. JMBBM, 175.

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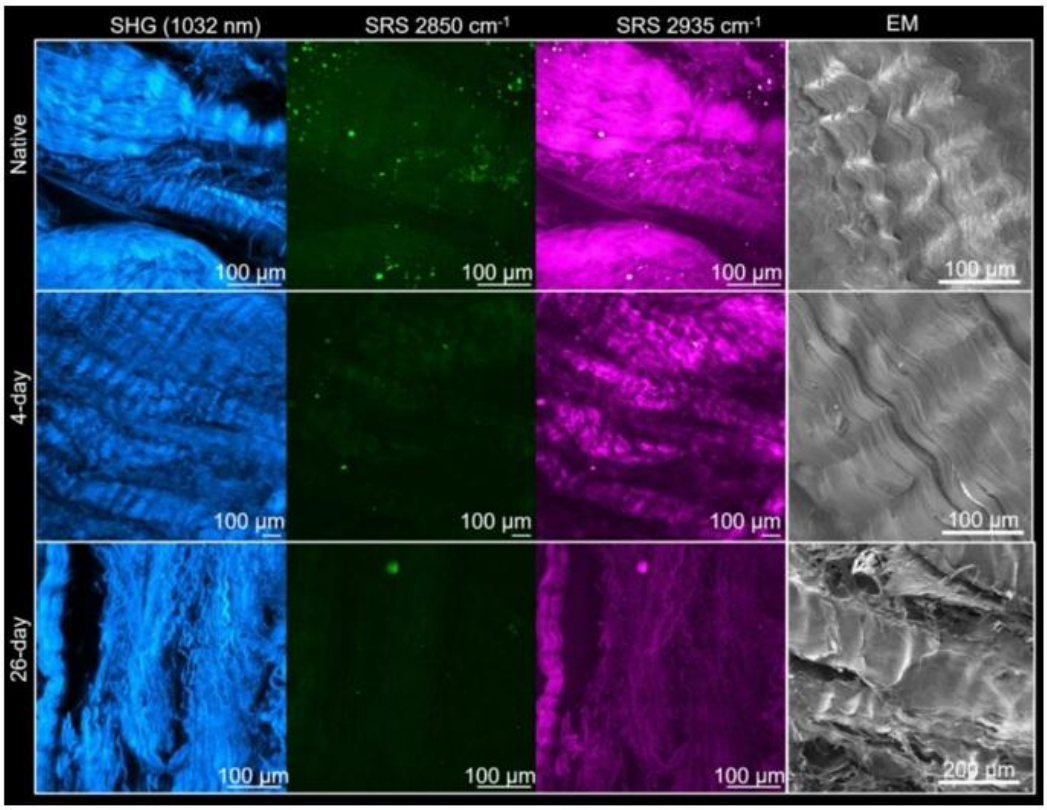

Multimodal imaging of native, 4-day and 26-day decellularised porcine tendon utilising second harmonic generation (SHG), stimulated Raman scattering (SRS) and scanning electron microscopy (EM).

Gait analysis following Anterior Cruciate Ligament primary repair with Internal Bracing versus reconstruction

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Abstract

Research Question: Anterior cruciate ligament (ACL) repair, where the ligament is re-attached and augmented with suture tape, maintains native anatomy and negates the need for autograft harvest that is usually required in ACL reconstruction. This may have implications for the recovery of gait asymmetries that often persist after ACL reconstruction. The aim of this study was to use 3-dimensional gait analysis to compare biomechanical outcomes following ACL repair with those after ACL reconstruction.

Methods: Nineteen ACL repair and nineteen hamstring ACL reconstruction patients (mean 4 years postoperatively) were recruited, along with twenty healthy volunteers. Lower limb kinematic data were measured during repeated overground walking tasks, using a 16-Bonita camera Vicon (Oxford, UK) 3D optical motion capture system and kinetic data recorded by two AMTI force plates (AMTI©, USA) embedded in the floor. Outputs were assessed using a custom lower limb model via Vicon Nexus and Matlab. The operated limbs of patients were compared with the uninjured limb, and between group differences for the operated limb of repair and reconstruction patients, and the dominant limb of healthy volunteers.

Results: There were no differences in patient factors between groups; mean age 29, 64% male, Tegner score 6.4. ACL repair patients showed no differences between operated and uninjured knees for any kinematic or kinetic measure during walking gait. Reconstruction patients demonstrated reduced knee extension angle and reduced knee flexion and extension moments in the operated limb during stance. Reconstruction patients demonstrated greater knee valgus angle and knee abduction moment during stance compared to repair patients and healthy volunteers.

Conclusions: Gait asymmetries are seen following ACL reconstruction but not following ACL repair. Abnormal knee loading could contribute to re-injury, influence functional performance and lead to osteoarthritis. The absence of these deficits in the repair group is an encouraging finding for outcomes in these patients.

Declaration of Interest

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Ceramic Hip Resurfacing Maintains Physiological Femoral Bone Strain Compared with a Cemented Stem: A Biomechanical Study

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[1]Imperial College London, London, United Kingdom. [2]Technion, Haifa, Israel. [3]University College London, London, United Kingdom

Abstract

Research Question: Hip resurfacing is re-emerging as a viable option for patients seeking high-intensity activity after surgery. Femoral resurfacing is theorised to better preserve native loading patterns, but this has not been evaluated in contemporary ceramic resurfacing systems. This study measured proximal femoral surface strains in composite femora across three states: native, ceramic femoral resurfacing, and a cemented polished taper-slip (PTS) stem.

Methods: Cortical strains were measured via full-field 3D digital image correlation in 18 large composite femora (N=6 per group) tested under physiological loading representative of single-leg stance during gait. Strains were quantified on the medial and lateral aspects of the proximal femur and mid-diaphysis.

Results: Ceramic resurfacing reproduced native femoral strain. In contrast, the cemented taper-slip stem reduced medial compressive strain by 49% at the calcar and by 28–33% across the proximal, middle, and distal regions (all $p < 0.05$), with no significant difference at the tip. Laterally, strain was reduced by 24–32% in the proximal, middle, and distal regions ($p \leq 0.042$), with no difference at the tip. No significant differences were observed between resurfacing and native femora at any region.

Conclusions: In this composite femur study, ceramic hip resurfacing exhibited a more physiological restoration of femoral surface strain compared with the cemented PTS femoral stem, particularly at the calcar and mid-diaphysis. Preservation of native load transfer may provide a favourable biomechanical environment for patients engaging in higher levels of physical activity and contribute to sustained bone quality and protect against mechanical failure long-term.

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Patient-specific finite element analysis of osteochondral autograft: press-fit stability and contact restoration under in vivo derived kinematics

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[1]University of Leeds, Leeds, United Kingdom. [2]University of Denver, Denver, USA

Abstract

Research Question: Osteochondral autograft subsidence and loosening remain common post-operative complications. Static loading in current FE models neglects flexion-dependent plug micromotion and the kinematic variability that could risk graft fixation. This work presents a patient-specific, fluoroscopy-driven FE framework that integrates in vivo tibiofemoral kinematics to evaluate press-fit stability and contact mechanics restoration across the full functional range of motion.

METHODS: A subject-specific FE model was constructed from CT images of a 54-year-old female volunteer. Bone properties were derived from greyscale density scaling and cartilage thickness from a CT-only statistical shape model. Tibiofemoral kinematics were obtained from high-speed stereo radiography (HSSR) during seated knee flexion/extension. A joint load of 500N was applied during the simulation. Four virtual conditions were simulated: intact condyle (control), osteochondral defect (OCD), and press-fit autograft with standard interference fit flush to the articular surface (OCG) and with 1mm protrusion (OCG+1). A 6.35mm diameter, 10mm deep plug was virtually harvested from the ipsilateral patellofemoral region. Peak contact pressure, contact area, subchondral bone stress and plug micromotion were recorded throughout the flexion arc.

RESULTS: The OCD increased peak lateral contact pressure by 31% and reduced contact area by 27%. The OCG case restored peak contact pressure to within 6% of control and contact area to 85% of intact. In contrast, OCG+1 generated contact pressures 2.6 times the control value (9.2MPa). Plug subsidence was 0.25mm for OCG and 0.9mm for OCG+1, with micromotion below 10 µm recorded at individual graft elements during flexion.

CONCLUSIONS: Results confirm that osteochondral defects substantially disrupt tibiofemoral contact mechanics, and that precise graft seating is critical: even 1 mm of protrusion generates contact pressures far exceeding physiological levels, with greater subsidence risk. This study demonstrates a translational pipeline integrating patient-derived in vivo kinematics, patient-specific implant sizing and the pre-clinical evaluation of novel osteochondral repair strategies.

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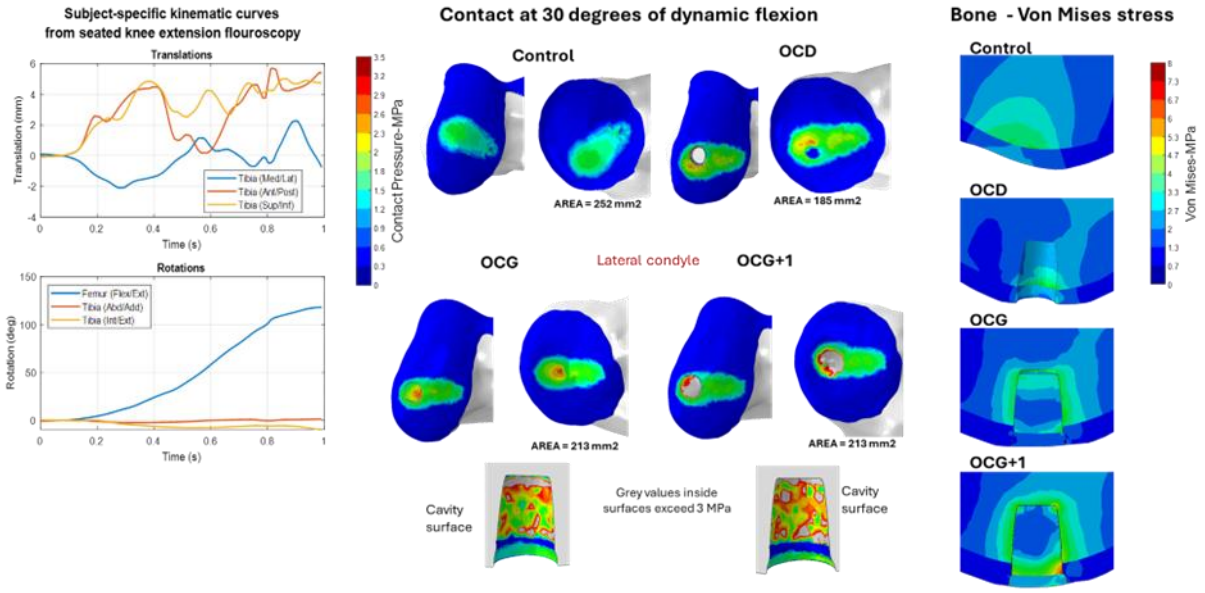

Characterising in-vivo lumbar disc mechanics using MRI and biplanar videoradiography

Katherine Prentice[1], Lauren Swain[1], Sashin Ahuja[2], Jude Meakin[3], Cathy Holt[1], David Williams[1]

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Abstract

Research Question: Lumbar disc deformation during functional loading remains challenging to quantify in vivo.[1]This study aimed to characterise regional disc deformation using MRI-derived anatomy and dynamic biplanar videoradiography.

Methods: Eight healthy adult volunteers underwent lumbar spine MRI and dynamic biplanar videoradiography during functional loading tasks. Preliminary analysis was performed in five volunteers (3F/2M, mean age 45 years), comprising 19 lumbar discs. MRI-derived vertebral models were registered to biplanar radiographs to determine dynamic vertebral poses for distance-map analysis. Disc height change was quantified across five anatomical regions: nucleus pulposus, anterior annulus fibrosus, posterior annulus fibrosus, and left and right lateral annulus fibrosus. Regional deformation was assessed during side bending, axial rotation and stoop lifting with a 10kg load.

Results: Regional deformation analysis was performed across five anatomical disc regions, 19 lumbar discs and three functional loading tasks. Median regional height change was larger during stoop lifting (2.6 mm), followed by side bending (2.1 mm) and axial rotation (1.8 mm). Across regions, larger median height changes were observed in the left lateral (2.6 mm) and anterior annulus fibrosus (2.5 mm), while the nucleus pulposus (1.7 mm) and posterior annulus fibrosus (2.0 mm) showed lower median deformation. Anterior-posterior asymmetry was observed across all activities, with anterior deformation generally exceeding posterior deformation, most notably during stoop lifting (median difference 0.7 mm). The disc level with the greatest deformation varied between participants and activities, with no single lumbar level consistently dominant across the cohort.

Conclusions: This study demonstrated a pipeline for quantifying regional lumbar disc deformation in vivo during functional loading. Preliminary findings showed task-, region- and participant-specific deformation patterns, supporting future investigation of relationships between MRI-derived measures of disc health and lumbar disc deformation.

Reference: [1]Elliott DM et al. NPJ Biomed Innov. 2026;3:15

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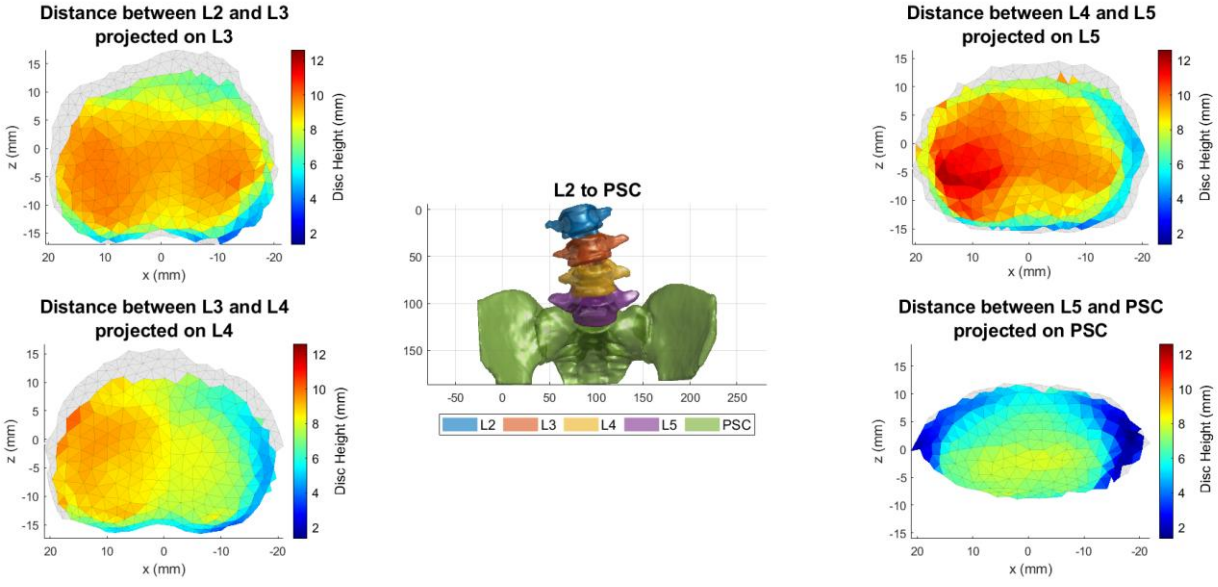

Session 3 – Clinical Technology

Predicting Early Aseptic Loosening in Total Knee Arthroplasty Using Longitudinal Deep Learning

Rory Ormiston[1], Vipin Asopa[2], Peter Harris[3], Doug Dunlop[1], Keith Tucker[4]

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Abstract

Research Question: Can a longitudinal deep learning framework applied to serial radiographs detect early aseptic loosening in total knee arthroplasty (TKA) before conventional radiographic signs become clinically apparent?

Methods: A retrospective, single-centre cohort study was conducted using patients who underwent TKA with the NexGen® Stemmed Option Tibial Component between 2003 and 2022. The dataset included 240 patients (120 revised for aseptic loosening and 120 controls with >10-year implant survival), comprising 1,736 radiographs. Images were preprocessed and transformed into high-dimensional embeddings using medical-domain foundation models. A longitudinal transformer-based architecture incorporating temporal modelling and cross-attention between anteroposterior and lateral radiographic views was developed. A “hard selector” mechanism prioritised high-information regions at the bone–implant interface. Model performance was evaluated using nested 5-fold cross-validation, with gross failures excluded from testing to focus on early detection.

Results: The ensembled model achieved a mean AUROC of 0.913 (95% CI 0.88–0.94) and accuracy of 0.83, outperforming single-model approaches. When restricted to early-detection conditions (excluding gross failures), performance remained robust (AUROC 0.852). Sensitivity and specificity were 0.76 and 0.79, respectively. Longitudinal modelling significantly improved performance compared to single time-point analysis (AUROC 0.91 vs 0.78), highlighting the importance of temporal data. Cross-attention between radiographic views improved AUROC by 3.4%, and model ensembling enhanced stability and accuracy.

Conclusions: This study demonstrates that deep learning can identify early, subclinical radiographic features predictive of aseptic loosening in TKA. By leveraging longitudinal imaging and multi-view integration, the model detects failure signals not appreciable through standard assessment. This approach represents a step toward clinically deployable AI tools for implant surveillance, with potential to enable earlier diagnosis, optimise patient outcomes, and reduce the burden of revision surgery.

Declaration of Interest

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Evaluating a 3D freehand ultrasound and motion capture fusion technique for patellofemoral kinematic assessment

Caterina Vanelli Coralli[1], Shifan Jack TU[2], Simon Abram[3], Stephen Mellon[4,2]

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Abstract

Research Question: Accurate quantification of patella tracking is crucial to the clinical assessment of abnormal kinematics, such as in post-operative mal-tracking following total knee arthroplasty; however, current diagnostic techniques remain limited. CT and MRI provide morphological detail but inadequately describe motion, while gait analysis imprecisely tracks patellar movement due to soft tissue artefacts. This study evaluates a novel ultrasound and motion capture fusion technique for quantifying patellofemoral kinematics across loaded knee flexion.

Methods: Ten healthy volunteers participated in the study. Two five-marker plates were placed on the proximal thigh and distal shin of the right leg. The knee joint was scanned with a hand-held ultrasound in one reference (9 sweeps, 10 minutes) and five pseudo-dynamic positions (6 sweeps, 3 minutes). The latter represented flexion angles (10º-75º) and loading covering the joint's range of motion during step-climbing. A four-camera Vicon MOCAP system was set up to simulate the spatial constraints of a consultation room A custom segmentation algorithm was optimised for the extraction of bone profiles from ultrasound images. Point cloud registration was used to reconstruct precise bony morphology at pseudo-dynamic positions. A femoral-based coordinate system was created using the femoral epicondyles, intercondylar notch, and long axis as reference points. Similarly, the patellar corners were identified and used to extract measurements for patellar mediolateral shift and tilt across the range of motion.

Results: The proposed system successfully performed proof-of-concept kinematic extraction, with mean patellar medial-lateral shift of [5.70±3.98]mm and tilt of [28.13±8.14]º at 45º flexion, demonstrating concordance with established literature.

Conclusion: The study confirmed the feasibility of using this technique in a clinical-like environment, overcoming limitations of current kinematic extraction methods. Ongoing work aims to translate this framework into a tool for assessment of healthy and pathological populations, with the longer-term objective of enabling fully dynamic assessments.

Declaration of Interest

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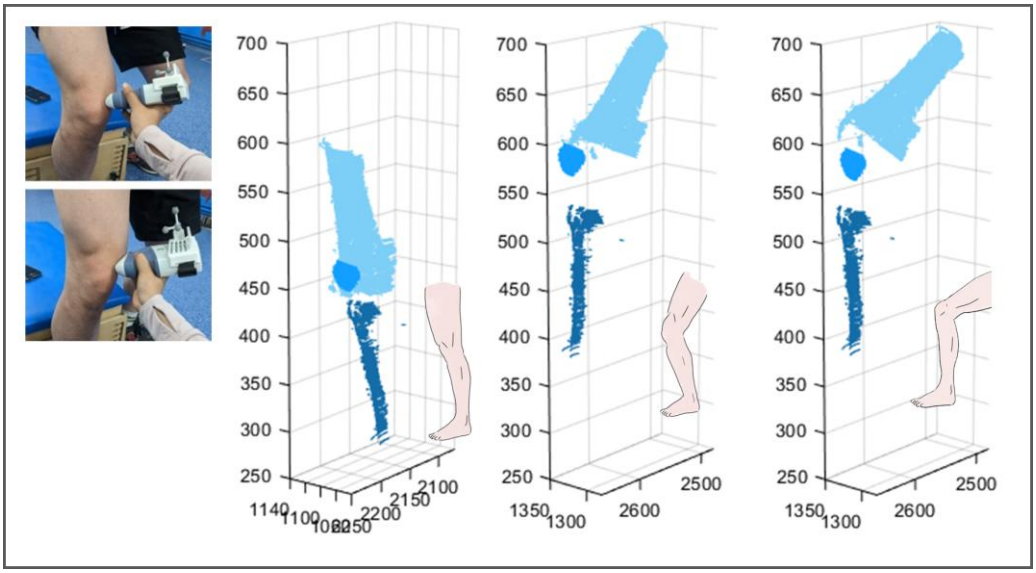

Evaluation of ankle joint structure in chronic ankle instability using ultrasound imaging and shear wave elastography.

Kimia Rezaei Fard[1], Gordon Hendry[1], Ruth Barn[1], Diane Dickson[2], David Hamilton[1]

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Abstract

Chronic ankle instability (CAI) is a prevalent condition, often following recurrent ankle sprains and associated with persistent mechanical and functional deficits. Musculoskeletal ultrasound, combined with shear wave elastography (SWE), enables non-invasive assessment of ligament structure and mechanical properties. This study aimed to evaluate ankle joint structure and stiffness in individuals with and without CAI under relaxed and stress conditions.

Twenty participants were recruited, including 10 individuals with CAI and 10 healthy controls (4 females, 6 males each), classified according to International Ankle Consortium criteria. Bilateral imaging was performed using a Samsung V8 ultrasound system. Anterior talofibular ligament (ATFL) length and subtalar joint (STJ) width were assessed using B-mode ultrasound, while ligament stiffness was quantified using SWE (shear wave velocity). Measurements were obtained under relaxed and stress (end-range plantarflexion and inversion) conditions, with three repetitions averaged. Stress-to-rest ratios were calculated. Group comparisons (control left, control right, CAI uninjured, CAI injured; n = 10 each) were analysed using one-way ANOVA with Tukey post-hoc testing ($p < 0.05$).

No significant differences were observed for ATFL length, elongation, or STJ width between groups ($p > 0.05$). SWE velocity at rest was significantly lower in CAI limbs compared to controls ($p < 0.01$). SWE ratio was significantly higher in both CAI injured and uninjured limbs relative to controls ($p < 0.01$). No significant differences were identified between control limbs or between CAI injured and uninjured limbs.

Findings indicate that CAI is not associated with detectable changes in ligament structure or joint morphology but is characterised by altered mechanical properties. Reduced resting stiffness alongside increased relative stiffening under stress suggests a modified load-response behaviour, potentially reflecting compromised tissue integrity with compensatory adaptation. The absence of differences between injured and uninjured limbs may indicate bilateral or systemic effects. SWE appears to provide greater sensitivity to functional deficits than conventional structural measures.

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Real-Time Tibial Force Sensing for Intraoperative Characterisation of Posterior Cruciate Ligament Tension in Cruciate-Retaining Total Knee Arthroplasty

Alistair Lawley[1], Andrew Brunt[1,2], Nima Razii[3], David Wallace[2], Hrvoje Vidakovic[2], Philip Riches[1], Gordon Dobie[1]

[1]University of Strathclyde, Glasgow, United Kingdom. [2]NHS Goldern Jubilee Hospital Trust, Glasgow, United Kingdom. [3]NHS Greater Glasgow & Clyde, Glasgow, United Kingdom

Abstract

Research Question: Intraoperative soft-tissue assessment in cruciate-retaining total knee arthroplasty (CR-TKA) relies on manual judgement. No objective method exists to simultaneously quantify tibiofemoral force and contact position during surgery. We asked whether a capacitive array tibial sensor could generate distinct, clinically interpretable signatures for balanced, overstuffed, and over-released medial cruciate ligament (MCL) states in real time.

Methods: A four-element capacitive array integrated into a standard tibial trial measured tibiofemoral force, medial-lateral balance, and anterior-posterior contact position simultaneously. Bench validation confirmed a mean force error of 1.2 N across a 0–350 N range. Four knees from two Thiel-embalmed cadavers underwent mechanically aligned CR-TKA. Insert thickness was increased (10–16 mm) to produce graded overstuffing, followed by staged MCL release (partial, moderate, complete) at the 16 mm condition.

Results: Force-flexion profiles were repeatable at baseline. Progressive overstuffing shifted the force peak into mid-flexion, approaching 300 N at 60°, consistent with MCL over-tension. Staged release produced stepwise correction: moderate release suppressed the mid-flexion force peak. Complete release reduced deep-flexion force to 25 N. Medial-lateral tracking discriminated all three states: the balanced knee showed a medial-to-lateral transition through flexion. Overstuffing exaggerated this excursion. Neither moderate nor complete release restored the normal transition, with the centroid remaining persistently medial, consistent with over-release. Anterior-posterior contact showed a posterior plateau at mid-flexion in balanced and overstuffed conditions, consistent with MCL-driven rollback and absent following moderate and complete release with near-zero posterior displacement, indicating loss of guidance.

Conclusions: Each sensing channel provided independent discrimination of balanced, overstuffed, and over-released MCL states. The convergence of all three signatures strengthens confidence in the sensor as an objective intraoperative tool. Real-time feedback has the potential to reduce reliance on surgical judgement for one of the most consequential soft-tissue decisions in CR-TKA.

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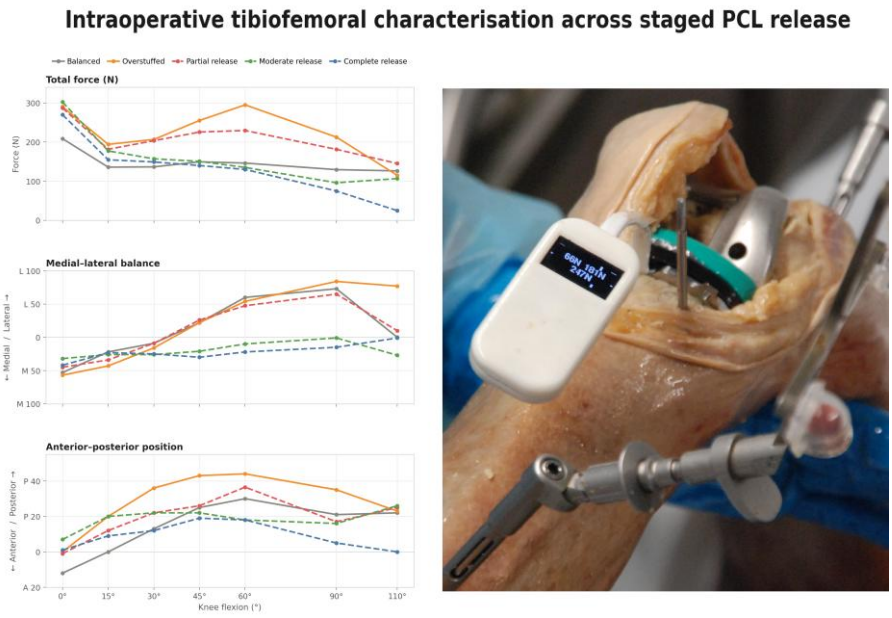

Functional pelvic orientation affects acetabular assessment and clinical interpretation in structural hip disorders

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[1]West China Hospital, Sichuan University, Chengdu, China. [2]University of Exeter, Department of Engineering, Exeter, United Kingdom

Abstract

Research Question: Does functional pelvic orientation on weight-bearing imaging influence acetabular assessment and clinical interpretation in structural hip disorders, including developmental dysplasia of the hip and femoroacetabular impingement?

Methods: Two complementary retrospective imaging-clinical studies were synthesized to examine the role of functional pelvic orientation in structural hip disorders. In the dysplasia study, 85 symptomatic patients underwent supine and erect weight-bearing anteroposterior pelvic radiographs and computed tomography. Acetabular retroversion was defined by a crossover index >0.2 on standing radiographs. Pelvic tilt, acetabular version, acetabular coverage, and hemipelvic morphology were compared between mixed-type dysplasia with acetabular retroversion and isolated dysplasia. In the impingement study, 90 patients with 97 symptomatic hips underwent arthroscopic treatment for femoroacetabular impingement. Standing pelvic radiographs were obtained preoperatively and 4 weeks postoperatively to assess compensatory pelvic tilt. Six-month outcomes included HOOS, mHHS, LEAS, EQ-5D, and satisfaction.

Results: In the dysplasia cohort, 26 of 85 cases, or 30.59%, demonstrated mixed-type dysplasia with acetabular retroversion. Transition from supine to standing produced significant posterior pelvic tilt: SFP increased from 64.35°±4.60° to 74.75°±4.16°, PSSC decreased from 6.37±2.47 cm to 2.08±1.32 cm, and PSSI decreased from 9.47±1.66 cm to 6.33±1.08 cm, all $p<0.001$. Supine radiographs identified 34 mixed-type cases, whereas standing radiographs identified 26 cases. Computed tomography showed reduced acetabular anteversion, increased anterior sector angle, reduced posterior sector angle, and altered hemipelvic morphology in mixed-type hips. In the impingement cohort, HOOS, mHHS, and LEAS did not differ between compensatory and normal pelvic position groups at 6 months, with $p=0.352$, $p=0.183$, and $p=0.865$, respectively. EQ-5D usual activities were better in the compensatory group, $p=0.044$.

Conclusions: Functional pelvic orientation is an important imaging factor in structural hip disorders. Weight-bearing pelvic radiographs better capture clinically relevant acetabular retroversion in dysplasias, while compensatory pelvic tilt in FAI does not compromise short-term arthroscopic outcomes.

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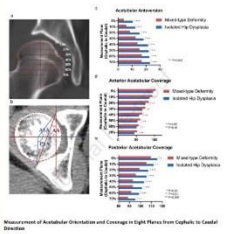
Functional pelvic orientation affects acetabular assessment and clinical interpretation in structural hip disorders

Postural change ⇨ Pelvic tilt ⇨ Acetabular retro/anteversion

A. DDH



Postural effect

SFP: 64.35° vs 74.75°
PSSC: 6.37 vs 2.08 cm
PSSI: 9.47 vs 6.33 cm

B. FAI

6-month outcomes

HOOS: p=0.352
mHHS: p=0.183
LEAS: p=0.865
No significant differences

- Standing weight-bearing imaging reveals functional pelvic orientation
- Mixed-type DDH + acetabular retroversion: 26/85 cases (30.59%)
- Supine-to-standing transition caused significant posterior pelvic tilt: all $p < 0.001$
- FAI compensatory pelvic tilt did not affect 6-month HOOS, mHHS, or LEAS
- Functional pelvic orientation should be incorporated into hip preservation assessment

Geometric Analysis of Surface Changes in Total Ankle Replacement Polyethylene Inserts

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Abstract

Research Question: Failure of total ankle replacement (TAR) has been associated with wear and deformation of polyethylene (PE) inserts; analysis of surface changes on retrievals may provide insight into failure modes and mechanisms (Haston et al., 2023). While coordinate measuring machine (CMM)-based methods for volumetric wear measurement and spatial analysis have been established for hip and knee replacements, no equivalent approach exists for TAR. This study aimed to develop a method to assess geometric surface changes of TAR PE inserts, evaluate the method using simulator-tested inserts, then apply it to retrievals.

Methods: Three groups of PE TAR inserts were assessed using CMM measurements and MATLAB processing: (1) Manufacturing variation; as-manufactured Zenith™ inserts (n=3) to estimate baseline variance. (2) Simulator validation; wear simulator-tested Zenith™ inserts (n=9) compared against as-manufactured controls, with volumetric measurements compared with gravimetric data. (3) Retrieval analysis; AES retrieved inserts (n=7) were compared against both an as-manufactured reference and a surface-reconstruction generated reference based on polynomial fitting of the talar surface geometry, to assess applicability where no pre-wear data is available. Results were compared with gravimetric data.

Results: Group 1: mean total volume variance between as-manufactured inserts was 34.1±6.7mm^3, providing an estimate of baseline manufacturing tolerance. Group 2: volumetric wear showed good agreement with gravimetric data (r=0.89). Surface deviation maps revealed localised material loss at the distal and peripheral talar regions, consistent with edge loading and possible fatigue-related failure patterns. Group 3: strong agreement with gravimetric data was found for both the as-manufactured control (r=0.96) and generated reference (r=0.97).

Conclusions: This study presents the development and evaluation of a CMM-based methodology for geometric assessment of TAR PE inserts, applicable to simulator-tested and retrieved implants. The method provides volumetric wear measurements and surface deviation maps, supporting improved understanding of TAR failure mechanisms and future implant development.

Declaration of Interest

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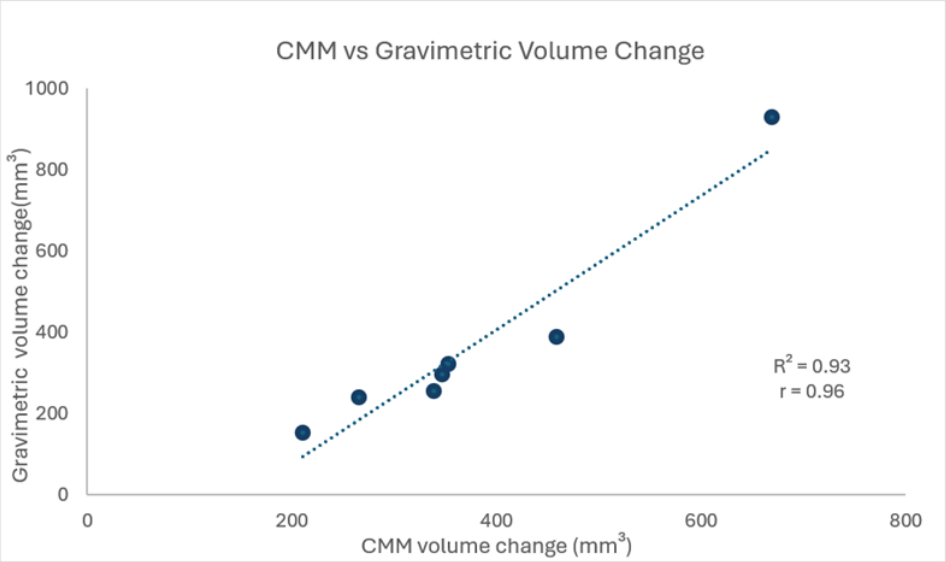

Figure 1. Comparison of CMM- and gravimetrically derived volume change estimates for retrieved TAR inserts.

TET2 Clonal Haematopoiesis may be linked to impaired recovery following Total Hip Replacement, a multimodal analysis

Ines Reichert[1], Ricardo Rodrigues[2], Patrick Li[1], Geraint Thomas[3], Karina Wright[4], Prodromos Chatzikyriakou[5], Sarah Mackie[5], Xuesen Zheng[5], Maria del Pilar Casares Alaez[5], Ghulam Mufti[5], Lynn Quek[5]

[1]King's College Hospital, London, United Kingdom. [2]Imperial College NHS, London, United Kingdom. [3]RJAH, Oswestry, United Kingdom. [4]Keele University, Oswestry, United Kingdom. [5]King's College London, London, United Kingdom

Abstract

Clonal haematopoiesis (CH) is a recognised common feature of human ageing and involves an expansion of somatically mutated blood cells, at a threshold of variant allele frequency (VAF) associated with blood and non-haematological cancers. Ch has been linked to inflammatory disease, however a relationship to osteoarthritis remains undefined. Studies concentrating on the anatomic compartment blood alone are likely to underestimate the problem as clone sizes are larger in bone marrow. This would affect detection sensitivity and implementation of diagnostic methodology.

Method: We studied 712 adults (≥50 years, median 70) who were mainly undergoing elective hip arthroplasty (THA) for osteoarthritis (OA). Using UMI-enabled targeted sequencing (49 genes) with 0.5% VAF sensitivity, we profiled CH in paired bone marrow (BM) and peripheral blood (PB) and longitudinal PB samples. The patients were thoroughly assessed clinically using validated scores.

Results: CH mutations were detected in 40.4% of patients. Furthermore, 20% (31/155) of patients meeting the 2% VAF threshold for CHIP diagnosis in BM would be missed by PB-only testing. Analysis of 55 clones across fractionated populations showed DNMT3A mutations to be broadly lineage-neutral, whereas TET2 mutations were enriched in granulocyte-monocyte progenitors and mature myelomonocytic cells. TET2 clones (n=15) were significantly biased towards myelomonocytic fates, underlying their role in innate immunity and inflammation. Clinically, CH+ status, driven mainly by TET2-CH patients, independently predicted poorer 1-year mobility recovery (beta=0.25, p=0.042) in THA patients. Median time to recovery in TET2-CH patients was 36 months, versus 12 months in non-CH controls. Longitudinal clonal modelling demonstrated higher TET2 fitness coefficients, correlating with age and pre-operative pain independently.

Conclusion: Genotype-specific fitness and myelomonocytic bias in TET2 correlate with impaired post-operative functional recovery, highlighting CH as a dynamic biomarker not only of age-related expansion but also of surgical resilience and a potential target for inflammation-modifying interventions.

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Session 4 – Biology

Sex based differences in IPSC derived nociceptor responses to osteoarthritic synovial fluid

Ryan Jones, Gemma Wilkinson, Chris Wilson, Deborah Mason

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Abstract

Objectives: Osteoarthritic pain affects 18% of females and 9.6% of males over 60 worldwide, with 62% of all osteoarthritic patients being female1. Women use more health care, have higher osteoarthritis prevalence, suffer more from debilitating pain, particularly post-menopause, and have more rapid disease progression2, however, the molecular drivers underlying this burden is unknown. We used a human iPSC derived nociceptor model to determine whether responses to human synovial fluids are sex specific.

Methods: Human nociceptors were generated using a method shown in Figure1A. Synovial fluid (SF) and serum was obtained from 28 female and 25 male subjects undergoing total knee replacement (TKR) and utilized in combination with nociceptor model (Figure1B).

Results: Oestradiol serum concentrations correlated with: MCSF (p=0.021,r=0.479), PDGFb (p=0.011,r=-0.520), RANTES (p=0.003,r=-0.585) and Leptin (p=0.015,r=0.510). Progesterone concentration also correlated with leptin (p=0.030,r=0.453). PCA of SF biomarkers revealed 11 PCs with eigenvalues >1. PC2 (7.82% total variance) positively weighted IL1RA (0.411), IL-8 (0.403) and negatively weighted FGF23 (-0.527) and Leptin (-0.595) separated males from females by multiple logarithmic regression (MLR) analysis p=0.0035. Transfer of OA synovial fluid reduced nociceptor firing frequency at 30 minutes, followed by a gain in activity. Negative peak area negatively associated with pain reporting in patients (OKS r=0.504,p=0.039; KOS r=0.553,p=0.033). PC2 score showed sex-specific effects on nociceptor activities. PC2 score in male synovial fluid negatively correlated with evoked gain in nociceptor function (r=-0.597, p=0.04) whereas in females it was positively correlated (r=0.715, p=0.013).

Conclusions: Factors that separate male and synovial fluid (positive IL1RA and IL-8, and negative FGF23 and Leptin) directly correlate with differences in nociceptor activity in males and females. These molecular mechanisms may contribute to nociceptive differences between male and females.

References 1. Long, H et al (2022) Arthritis & Rheumatology 74, 1172–1183. 2. Tschon et al (2021). J Clin Med 10, 3178.

Declaration of Interest

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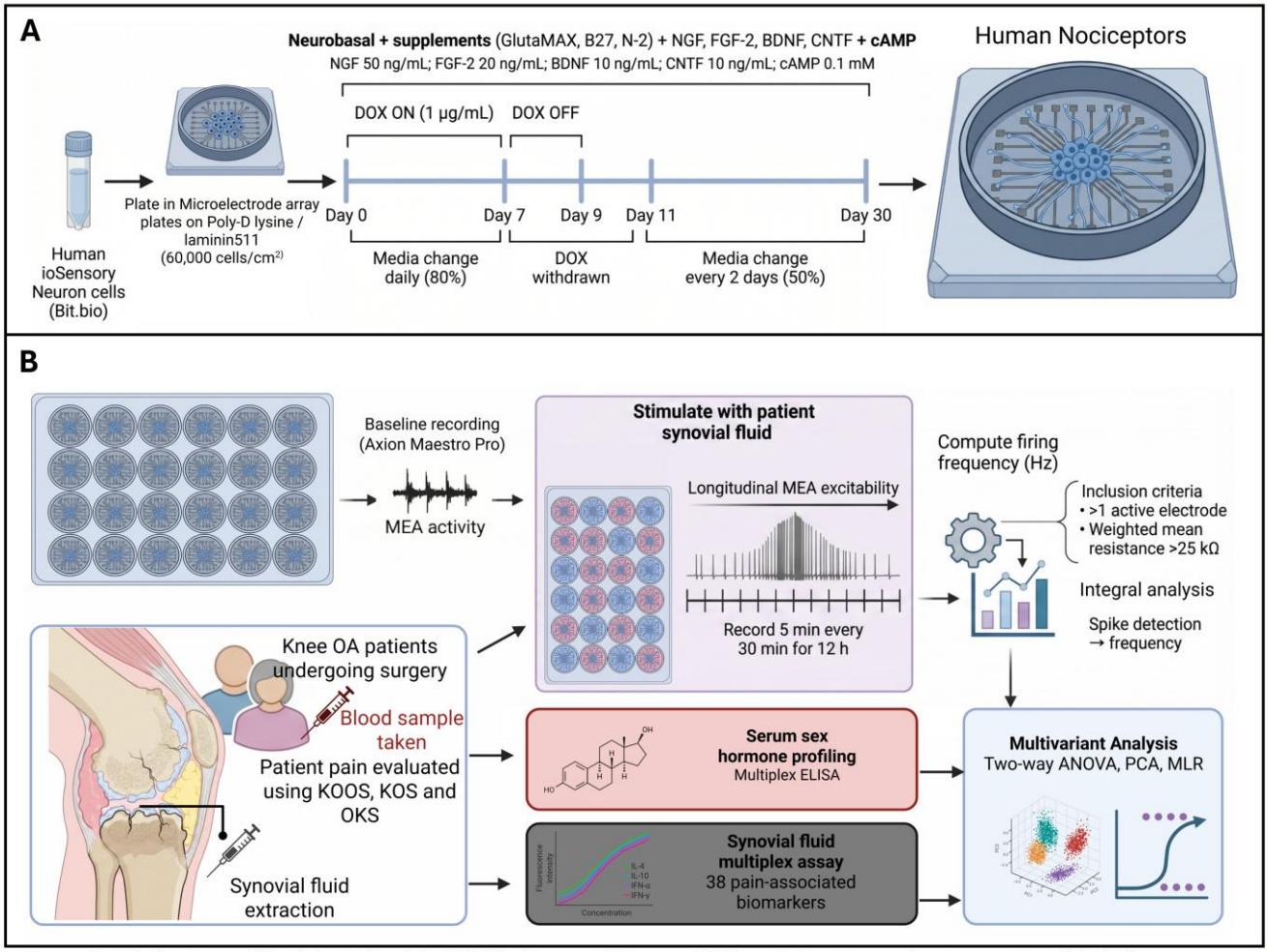

Figure 1. Methods used in this study. (**A**) iPSC ioSensory Neuron differentiation to nociceptor protocol. (**B**) Sensory neuron microelectrode array (MEA), synovial fluid analysis and stimulation experimental approach

Type I Interferon Signalling Drives Stromal–Immune Crosstalk and Dendritic Cell Activation in Tendinopathy

Clara Burgy

College of Medical, Veterinary & Life Sciences, University of Glasgow, Glasgow, United Kingdom

Abstract

Research Question: Does type I interferon signalling mediate stromal–immune crosstalk in tendinopathy by linking tenocyte activation to dendritic cell (DC)–driven inflammation?

Methods: Human supraspinatus (tendinopathic) and hamstring (control) tendon biopsies were analysed for IFNα and $CD1c^+$ DCs using immunohistochemistry and qPCR. Primary human tenocytes were stimulated with recombinant IFNα, and gene expression, cytokine release, and proliferation were assessed (qPCR, ELISA, BrdU). Monocyte-derived DCs (Mo-DCs) were generated from PBMCs and stimulated with tenocyte-conditioned media collected under baseline, mechanical injury (scratch), and damage-associated conditions. DC activation was assessed by qPCR, ELISA, and flow cytometry.

Results: IFNα and $CD1c^+$ DCs were detected in tendinopathic tendon, supporting an immunologically active microenvironment. IFNα stimulation induced a conserved chemokine response in tenocytes, with upregulation of CCL2 and CCL5 in both healthy and diseased cells. Context-dependent effects were observed, with increased MMP3 and IL6 expression in tendinopathic tenocytes, while healthy tenocytes showed downregulation of COL1A1, COL3A1, and POSTN. IFNα also increased proliferation in healthy tenocytes only.Tenocyte-conditioned media induced robust DC activation, characterised by increased expression of CD40, CD86, CD141, and HLA-DRA, alongside increased IL-8 and TNFα production at transcript and protein levels. DCs also exhibited upregulation of IFNAR1, indicating enhanced responsiveness to type I interferon signalling.

Conclusions: Type I interferon signalling links tenocyte activation to dendritic cell–mediated inflammation in tendinopathy. IFNα induces a conserved chemokine response alongside context-dependent stromal changes, while tenocyte-derived signals drive DC activation and increase interferon sensitivity. These findings support a self-amplifying stromal–immune loop that may underpin persistent inflammation and failed repair.Targeting type I interferon signalling may represent a novel therapeutic strategy to disrupt immune-driven tendon pathology and improve tissue healing outcomes.

Declaration of Interest

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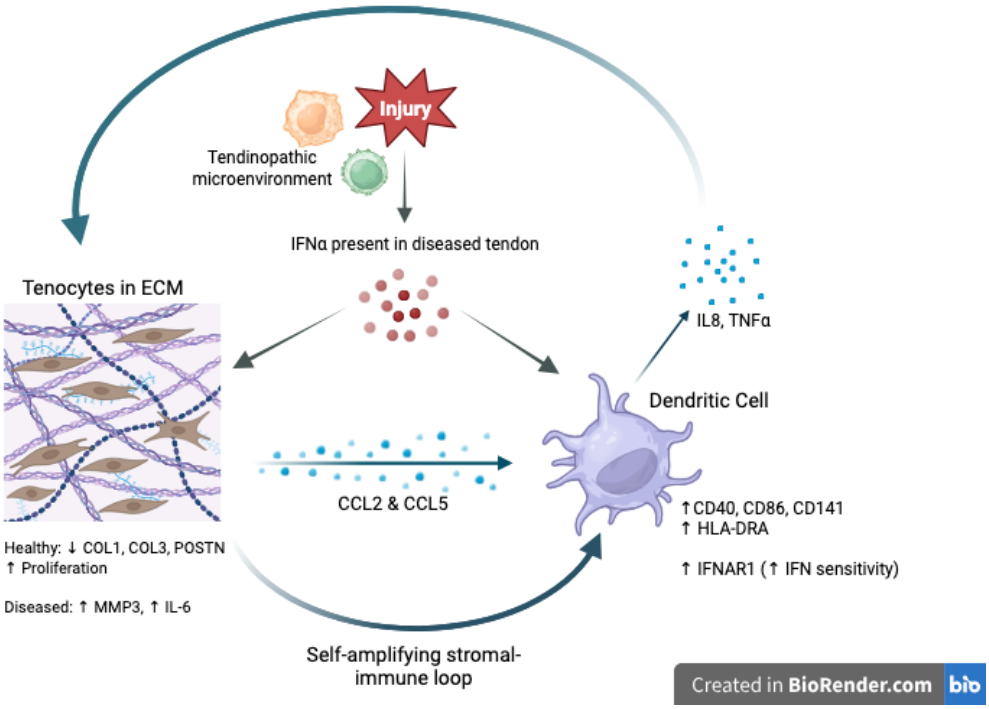
Injury
Tendinopathic microenvironment
IFNα present in diseased tendon
Tenocytes in ECM
IL8, TNFα
Dendritic Cell
CCL2 & CCL5
↑CD40, CD86, CD141
↑ HLA-DRA
↑ IFNAR1 (↑ IFN sensitivity)
Healthy: ↓ COL1, COL3, POSTN
↑ Proliferation
Diseased: ↑ MMP3, ↑ IL-6
Self-amplifying stromal-immune loop
Created in BioRender.com

Unlocking the origin of Benninghoff arcades: is strain-directed alignment the architect of the stratified organisation of mature articular cartilage?

ILYAS KHAN, Anu Patabandi-Mudiyanselage, Deb Roy, Manjit Singh

Swansea University, Swansea, United Kingdom

Abstract

Our understanding of how articular cartilage transitions from a developmental scaffold to a load-bearing tissue is poor and limits our ability to understand tissue morphogenesis and engineer functional replacements. Collagen organisation in immature cartilage is isotropic which then remodels postnatally into a highly organised, anisotropic arcade-like structure first described by Benninghoff in 1925. Whilst it is often assumed this postnatal transition requires matrix turnover, we hypothesise that the organisational potential for the adult fibril structure is inherent within immature tissue and can be mechanically unmasked through reconfiguration of the pre-existing collagen network. To test this, immature bovine cartilage explants were subjected to laterally confined plane-strain transverse compression, inducing significant longitudinal expansion via the Poisson effect. Polarised light microscopy revealed an unambiguous reorientation of deep-zone fibrils to lie perpendicular to the surface mirroring adult cartilage collagen architecture, additionally isolated chondrocytes were reorganised to form columnar stacks. Raman spectroscopy analysis revealed compressed cartilage has a significantly lower amide I peak, a spectral shift driven by polarisation-dependent extinction which provides molecular evidence of rapid fibrillar reorientation. The invariance of spectral peaks for collagen triple helix stability show that the molecular integrity of fibrils is preserved despite high-magnitude deformation. Genipin crosslinking of cartilage completely inhibited fibril reorientation providing evidence that fibril alignment is dependent on the physical mobility of the immature fibril network. These results suggest that directed mechanical strain, rather than de novo synthesis, is the primary architect of mature cartilage anisotropy, offering a rapid, biomimetic strategy for functional articular cartilage tissue engineering.

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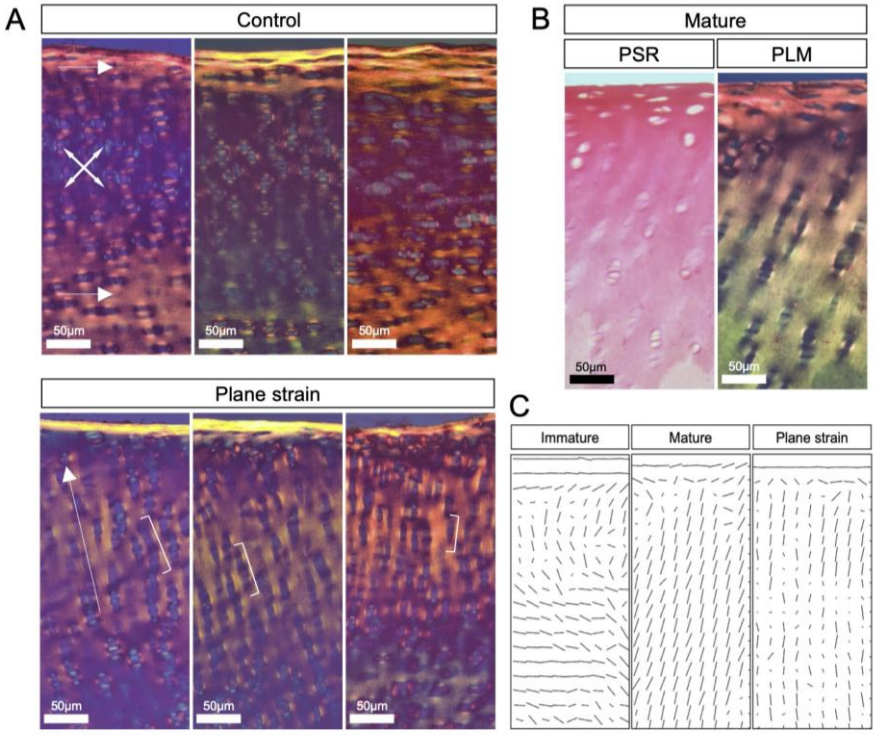

Figure. Plane strain compression of immature cartilage induces fibril realignment that mirrors adult articular cartilage. Immature cartilage cylinders, 2mm diameter, were laterally confined and transversely compressed 50% allowing them to expand along their longitudinal axis. Cartilage cylinders were fixed and sectioned then stained with picro-sirius red (PSR) and viewed under polarised light microscopy to visualize fibril direction *(n=3)*. **A**) Controlled uncompressed explants under PLM display parallel alignment of collagen fibrils at the surface, below which signal decreases indicating unorganised fibril arrangement (*crossed arrows*) below which are more parallel fibrils. Cartilage that has been subjected to plane strain compression show reorganisation of fibrils so they lie perpendicular to the surface (*single arrow*). Furthermore, chondrocytes are now arranged in columns (*brackets*), similar to mature articular cartilage as shown in **B**). **C**) Image analysis using ImageJ plugin OrientationJ generates vector maps of fibril direction for immature, mature and immature plane strain compressed articular cartilages. These vector maps are confirmation of fibril direction detected by PLM.

Beyond Hormonal Changes: Bone Mineral Nanostructure as a Critical Determinant of Osteogenic Impairment in Postmenopausal Osteoporosis

Mostafa Khabooshani, Laoise McNamara, Stanislas Von Eu, Syeda Masooma Naqvi

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Abstract

Research Question: Postmenopausal osteoporosis is associated with alterations in bone mineral nanostructure, particularly a reduction in the amorphous surface layer (ASL) of nano-hydroxyapatite (nHA). This study investigated whether these nanoscale changes in mineral crystallinity impair osteoblast differentiation, mineralization, and mechanobiological responses under estrogen deficiency and mechanical stimulation.

Methods: Platelet-shaped nano-hydroxyapatite (nHA) particles with controlled ASL proportions representing healthy (HE: 35% ASL) and osteoporotic (OS: 20% ASL) bone mineral were synthesized and characterized by TEM, XRD, and SSNMR. These proxies were incorporated into gelatin hydrogels and seeded with MC3T3-E1 pre-osteoblasts under continuous estrogen (E) or estrogen withdrawal (EW) conditions for 42 days, in static or mechanically stimulated conditions using a bioreactor. Osteogenic differentiation (ALP, BSP, OPN, VEGF, DMP1, SOST), mineralization (Von Kossa, calcium quantification, SEM, Nano-CT), and mineral density were assessed.

Results: Osteogenic Differentiation: The osteoporotic proxy (OS) inhibited osteoblast maturation compared to the healthy proxy (HE), showing sustained high expression of early markers (ALP, BSP, OPN) from day 21 to 42, with only a slight increase in late markers (DMP1, SOST) in the same period. In contrast, the healthy proxy supported superior osteocyte differentiation, with clear downregulation of early markers and strong upregulation of late markers (VEGF, DMP1). Mineralization: Von Kossa staining and calcium content confirmed reduced mineralization in OS-E than HE-E. Nano-CT analysis revealed significantly lower mineral density in the OS-E group compared to HE-E under mechanical stimulation. Notably, the OS-EW showed higher bone volume fraction (BV/TV) than OS-E; however, overall mineral density remained reduced.

Conclusions: Osteoporotic mineral crystallinity impairs osteoblast-to-osteocyte transition and reduces mineral density under mechanical stimulation, with effects exacerbated by estrogen deficiency. These findings underscore the critical role of bone mineral nanostructure in postmenopausal osteoporosis and highlight that accurate in vitro modelling of osteoporosis requires not only recapitulation of hormonal changes but also faithful representation of the altered mineral nanostructure.

Declaration of Interest

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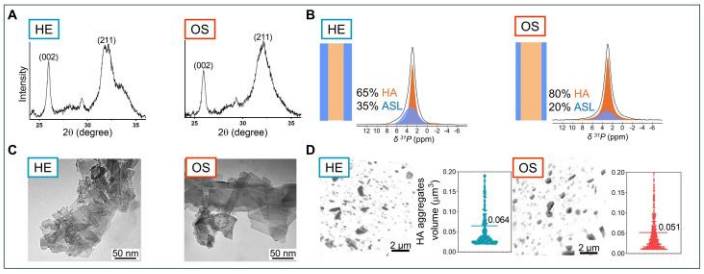
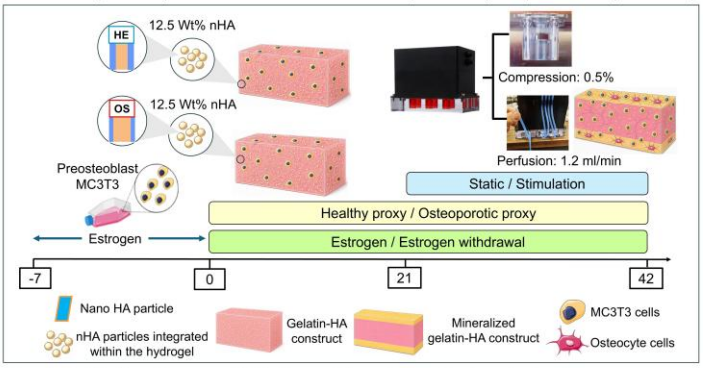
Beyond Hormonal Changes: Bone Mineral Nanostructure as a Critical Determinant of Osteogenic Impairment in Postmenopausal Osteoporosis

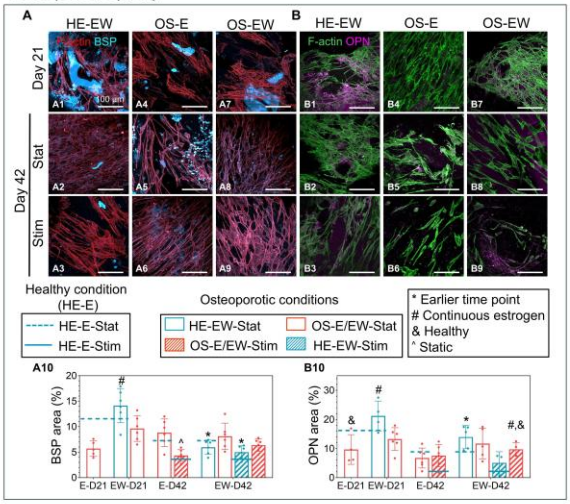
Panel 1 : Characterization of Healthy (HE: 35% ASL) and Osteoporotic (OS: 20% ASL) nano-hydroxyapatite proxies: **(A)** XRD, **(B)** SSNMR, **(C)** TEM, **(D)** Nano-CT



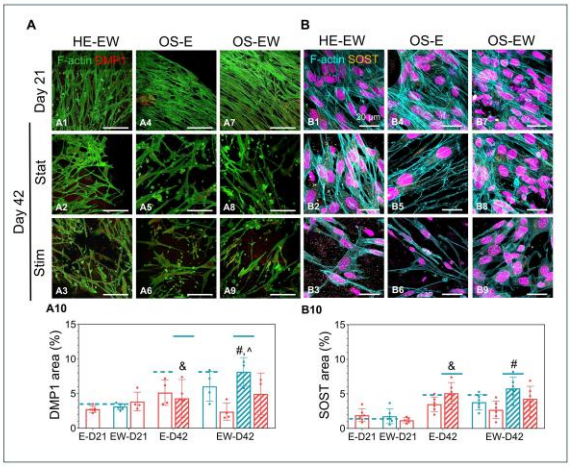
Panel 2: Experimental design showing 3D gelatin-nHA hydrogel models, estrogen conditions (E vs EW), and mechanical stimulation protocol (compression + perfusion)



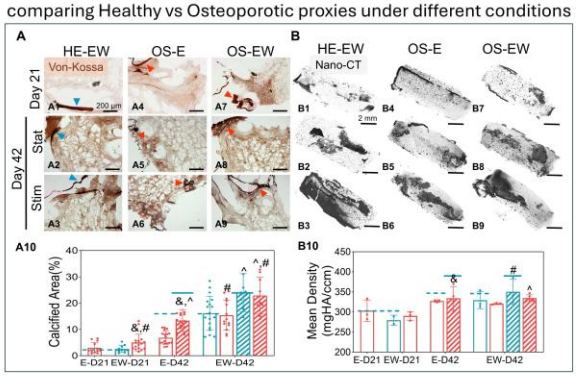
Panel 3: Expression of early osteogenic markers **(A)** BSP and **(B)** OPN at day 21 and day 42 demonstrating sustained high levels in osteoporotic proxy



Panel 4: Expression of late osteogenic markers **(A)** DMP1 and **(B)** SOST at day 42 showing enhanced maturation in Healthy proxy under mechanical stimulation



Panel 5: **(A)** Von-Kossa and **(B)** Nano-CT analysis of mineral density comparing Healthy vs Osteoporotic proxies under different conditions



Representative images and data from ongoing study (Khabooshani et al., manuscript in preparation).

Sex and hormonal status regulation of joint pathology, pain behaviour and DRG neuroimmune responses in early osteoarthritis

Wacharapol Saengsiwaritt[1], Anabelle Smith[2], Alexandros Lamprou[2], John Cole[2], Lynette Dunning[2], John Lockhart[3], Carl Goodyear[2], Carmen Huesa[2]

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Abstract

Research Question: Sex differences in osteoarthritis (OA) prevalence and severity are well recognised, particularly in postmenopausal women, yet the contribution of sex hormones to OA pathophysiology remains unclear. This study aimed to determine how sex and hormonal status influence early OA progression and pain-associated molecular signatures using a murine injury model.

Methods: Destabilisation of the medial meniscus with cartilage scratch (DCS) was performed in male, female and ovariectomised (OVX) mice. Joint pathology was assessed by µCT and histology. Pain-related behaviour was evaluated using dynamic weight bearing. Circulating hormones were quantified. Bulk RNA sequencing of dorsal root ganglia (DRG) assessed neuroimmune responses through paired analysis of the OA-affected limb and contralateral control.

Results: Despite equivalent cartilage injury, OVX mice showed increased synovitis and osteophyte formation, including contralateral joints (male vs OVX: −0.62, 95% CI −0.99 to −0.24, p = 0.0006; female vs OVX: −0.59, −0.97 to −0.22, p = 0.0011), indicating a heightened inflammatory state. DCS significantly reduced circulating estradiol in females compared to sham (339.1, 131.2 to 547.1, p = 0.0005), reaching OVX levels.Pain-related changes were observed in all injured groups, with significant effects in male and OVX mice (male: −4.67, −9.06 to −0.28, p = 0.0376; OVX: −4.65, −9.05 to −0.25, p = 0.0389), while females showed a non-significant trend (−3.93, −8.26 to 0.40, p = 0.0744). No differences were observed between sexes.Paired (OA vs contralateral side) DRG transcriptomics revealed sex-specific responses: females showed interferon gamma-associated immune signalling with neuronal suppression, whereas males showed increased neuronal excitability, proliferative remodelling and immune activation. OVX mice showed minimal transcriptional changes.

Conclusions: Sex and hormonal status shape early OA pathology, pain and neuroimmune signalling. Contralateral osteophytes in OVX mice with limited DRG changes may reflect menopause-associated musculoskeletal pain mechanisms, supporting sex-specific therapeutic strategies.

Declaration of Interest

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Integrated Lipidomic and Metabolomic Profiling Reveals Stage Dependent Changes and Metabolic Signatures Associated with Clinical Response Following Autologous Chondrocyte Implantation

Yumna Ladha[1,2], Adam Burke[3], Nigel Gotts[3], Royston Goodacre[3], Karina Wright[1,2], Jade Perry[1,2], Paul Jermin[4], Pete Gallacher[4], Charlotte Hulme[1,2]

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Abstract

Metabolomics enables characterisation of biochemical changes in synovial fluid (SF) and provides insight into processes underlying cartilage repair and treatment response. This study investigated metabolic changes associated with clinical response and surgical stage in patients undergoing Autologous Chondrocyte Implantation (ACI), integrating lipidomic (UHPLC–MS) and metabolomic (GC–MS) profiling.SF samples were collected from 26 patients at: Stage 1 (cartilage harvest) and Stage 2 (chondrocyte implantation).

Patients were classified as responders (R, n=15) or non-responders (NR, n=11) based on 12-month Lysholm score improvement (+14.6 minimal clinically important difference). Data was analysed in R (v4.3.2) using paired linear modelling with empirical Bayes moderation (limma), with false discovery rate (FDR) correction applied ($p<0.05$).

Lipidomic analysis identified strong stage dependent effects, with 749 lipids significantly altered between stage 1 and 2 samples. Pathway analysis revealed enrichment of sphingolipid metabolism, driven by increased ceramides and sphingomyelins at stage 2, particularly Cer(d18:1/16:0), consistent with activation of pathways related to tissue injury, stress signalling, and remodelling. Additionally, 89 lipids were unique to NR at stage 2 during this shift, predominantly phosphatidylcholines and lysophosphatidylcholines, key mediators of inflammation.

To further assess associations with outcome, partial least squares regression using change in Lysholm score from baseline to 12-month outcome, identified key metabolites with high variable importance (VIP>1.5), including amino acids (isoleucine, phenylalanine, proline, norvaline, lysine), organic acids, and energy-related metabolites (hydroxybutanoic and keto acids). Oxidative stress markers (pyroglutamic acid, uric acid) were also identified. All showed negative coefficients, indicating higher levels were associated with poorer clinical improvement.

Overall, global differences between response groups were limited, but feature-level and multivariate analyses revealed coordinated metabolic changes associated with poorer outcomes. Lipidomic alterations were primarily driven by surgical stage, while enrichment of inflammatory and stress related metabolites in NR suggests potential mechanisms underlying treatment response.

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Tissue of Origin Defines Transcriptional States in Osteoarthritis-Derived Mesenchymal Stem Cells

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[1]Cambridge University, Cambridge, United Kingdom. [2]Addenbrookes Hospital, Cambridge, United Kingdom

Abstract

Background: Mesenchymal stem cells (MSCs) are promising candidates for regenerative therapies in osteoarthritis (OA), yet the influence of tissue-of-origin on MSC identity remains incompletely understood.

Methods: MSCs were isolated from bone, cartilage, synovium, and fat pad tissues obtained from patients undergoing total knee replacement for OA. Bulk RNA sequencing and pathway analyses were performed to compare transcriptional profiles across tissue sources.

Results: Although all cultures expressed canonical MSC markers, distinct tissue-specific transcriptional programmes persisted following expansion in vitro. Cartilage-derived MSCs retained chondrogenic and extracellular matrix signatures, synovium-derived MSCs exhibited inflammatory and immune-related programmes, bone-derived MSCs showed osteogenic signatures, and fat pad-derived MSCs demonstrated adipogenic enrichment. Cartilage- and synovium-derived MSCs also displayed weaker multipotency-associated transcriptional signals compared with bone- and fat pad-derived MSCs.

Conclusions: Tissue-of-origin is a major determinant of MSC transcriptional identity in OA-derived cultures. These findings suggest that MSC populations are not biologically equivalent and that tissue source should be carefully considered in regenerative medicine and OA therapeutic strategies.

Declaration of Interest

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Session 5 – Bioengineering and Translational

Proteomic Profiling of Osseointegration in an Ovine Femoral Condyle Model

Sasza Chyntara Nabilla[1], Thomas A.G. Hall[1], Luyang Xu[1], Bruno M. Gil Rosa[1], Gordon Blunn[2], Frederic Cegla[1], Richard J. van Arkel[1]

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Abstract

RESEARCH QUESTION: Osseointegration is regulated by complex molecular signaling driving dynamic gene and protein changes. Although histology describes macroscopic events, underlying molecular mechanisms remain unclear. This study applied proteomics to better characterize osseointegration.

METHODS: Titanium implants (Ø8 x 16 mm; cp-Ti) were placed in femoral condyles of skeletally mature ewes (N=8). Drill debris was collected at day 0 and 42 (Fig. 1a-b). Samples were collected in RNA later and stored at -80°C. Proteins were extracted and analyzed by LC-MS. Protein identification used DIA-NN with UniProt Ovis aries as a reference. Data were processed in MATLAB and analyzed in R (limma). Proteins with logFC > 1 or < -1 (FDR<0.05) were considered differentially expressed. Pathway enrichment was assessed in GSEA. Histology and SEM assessed osseointegration. The study was performed in the UK under Home Office License No. P16F4AA0A.

RESULTS: Relative to day 0, 7,806 proteins were identified, with 655 upregulated and 988 downregulated (Fig. 1c). At day 42, the bone-implant interface remained highly active, with robust ECM assembly and collagen maturation (POSTN, TNC, COLs, SERPINH1, P4HA1/2). In parallel, GSEA showed enrichment of protein synthesis and secretion pathways, including collagen fibril organization, protein hydroxylation, COPII/ER-Golgi transport, and translation-related process. Osteoclast-mediated remodeling (e.g., ATP6V0D2, CTSK) was evident. Mineralization appeared incomplete, with increased PHOSPHO1 but no elevation of late osteogenic markers (e.g., BGLAP) or bone mineralization/ossification pathways. Histology (Fig. 1d) and SEM confirmed moderate osseointegration, with new woven bone formation, partial mineralization, and interfacial gaps.

CONCLUSION: Proteomic and histological analyses indicate active collagen assembly, with mineral deposition initiated but not yet broadly advanced, along with ongoing bone remodeling at the bone-implant interface. Future studies should include earlier intervals (e.g., days 7-28) to better capture progression to mature bone formation. ACKNOWLEDGEMENTS: UKRI (EP/Z533415/1), Wellcome Trust (223797/Z/21/Z), Imperial (DT-Prime, FILM).

Declaration of Interest

(a) fully declare any financial or other potential conflict of interest

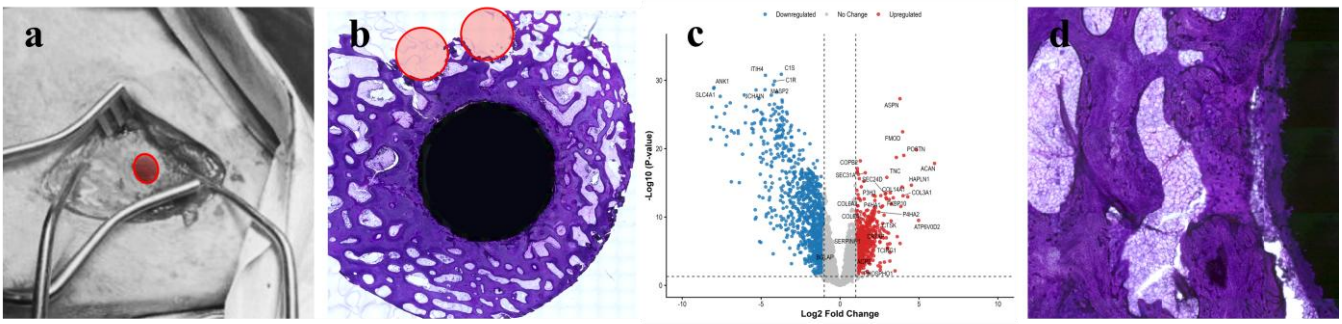

Figure 1. Proteomic analysis of bone tissue samples collected (a) from the femoral condyle immediately prior to the insertion of a titanium implant and (b) periprosthetic tissue 42 days later, revealing (c) 655/988 up-/downregulated proteins during (d) the matrix maturation phase of osseointegration.

Impact of International Transport on Clinical Osteochondral Allograft Viability and Integrity: A Controlled Comparison

Tomas Link[1,2], Karina Wright[3,2], Martyn Snow[3,4]

[1]Keele University, Stoke-on-Trent, United Kingdom. [2]The Robert Jones and Agnes Hunt Orthpaedic Hospital, Oswestry, United Kingdom. [3]Keele University, Stoke-On-Trent, United Kingdom. [4]The Royal Orthopaedic Hospital Birmingham, Birmingham, United Kingdom

Abstract

INTRODUCTION: In the UK, osteochondral allografts (OCAs) are sourced from US tissue banks, requiring transatlantic transport prior to implantation, with an unclear impact on graft quality. This study aimed to characterise cellular, structural, biochemical and metabolomic changes in OCAs and evaluate the effect of international transport on graft integrity.

METHODS: Osteochondral tissue from UK donors (n = 7) was assessed at 7-day intervals over 42 days of storage at 4 °C. Surplus OCAs from US donors (n = 7) were analysed within 24 hours of implantation, 22 to 28 days post-retrieval. Outcome measures included chondrocyte viability, zonal distribution, histology, water content, and sulphated glycosaminoglycan quantification. Metabolic alterations were assessed using ^1H NMR spectroscopy with multivariate analysis. Temperature and pressure loggers characterised transport conditions.

RESULTS: Storage time reduced chondrocyte viability (P=0.0003), with UK grafts declining to 63.9% ±7.4 by day 28. US grafts analysed 22 to 27 days post-harvest showed lower extracted viability (mean: 28.5%, range:8.6-56.7%). Total *in-situ* viability at day 28 in UK grafts was 71.0% ± 3.5 versus 27.3% (range:9–45.3%) in US grafts, with similar zonal reductions. No differences were observed in water content or sulphated glycosaminoglycan levels. Histology of US grafts showed superficial glycosaminoglycan loss in 3/7, combined superficial and middle zone loss in 3/7, and focal superficial loss in 1/7, with superficial structural damage in 5/7 grafts. Metabolomic analysis of US conditioned media identified enrichment of glutathione metabolism (FDR=0.013; impact=0.126) and porphyrin metabolism (FDR=0.033), with several amino acid pathways approaching significance. Transport logging showed mean shipment duration of 66.5 hours, mean temperature 0.7 °C ± 0.7, and reduced barometric pressure during flight.

CONCLUSIONS: US-sourced OCAs showed reduced viability at implantation. Transport near 0°C may induce freeze–thaw damage and oxidative stress, highlighting targets for preservation strategies.

Declaration of Interest

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Cellular Response to Implant-Delivered Ultrasound

Cosmo Prince, Sasza Nabilla, Kenton Wong, Fred Cegla, Thomas Hall, Richard Van Arkel

Imperial College London, London, United Kingdom

Abstract

RESEARCH QUESTION: Delayed osseointegration increases complication risk and prolongs recovery. Ultrasound stimulation can enhance bone healing, but the cellular response to implant-delivered stimuli, remains unclear. This study investigates osteoblast responses to ultrasound delivered via an active implant.

METHODS: Titanium implants (Ti-6Al-4V; surface roughness Rz =500 µm) were coupled to piezoelectric transducers. The transducers emitted 2MHz ultrasound through the implant to vibrate the osseointegration surface. The stimulus was characterised using a hydrophone. MC3T3-E1 murine pre-osteoblast cells were seeded onto each implant and cultured for 28 days (37˚C, 5% CO2). Osteoblastic response was measured for three conditions: 30 minutes/day (US30), 10 minutes/day (US10), and non-stimulated controls (n ≥3 per group). Cell metabolic activity, differentiation and collagen deposition were assessed using AlamarBlue, Alkaline Phosphatase (ALP) activity and Picrosirius Red, respectively. Mineralisation was fluorochrome-labelled at 7-day intervals, while cell and tissue morphology were studied using SEM.

RESULTS: Across all groups, metabolic activity increased by day 14, reaching significance in US10 and control groups. ALP decreased significantly from day 14 to 21 (35% reduction; $p < 0.01$), indicating typical progression to matrix deposition and mineralisation. This was supported by spatially corresponding collagen deposition and mineralisation. By day 21, metabolic activity was three-fold higher in US10 versus the controls (13.0±2.2 vs 4.3±2.4; $p=0.019$). Fluorochrome labelling revealed concentrated regions of mineral deposition in both stimulated groups (US10 & US30), with patterns similar to ultrasound stimulus maps. SEM revealed expansive aligned fibrillar collagenous matrix bridging implant surface features. This morphology was absent in controls.

CONCLUSION: Through-implant ultrasound stimulation increased cellular metabolic activity (US10) and altered mineralisation patterns and matrix morphology (US10 & US30), producing an organised, expansive collagenous extracellular matrix. These findings support the use of implant-delivered ultrasound to modulate osteoblast behaviour and potentially accelerate osseointegration. ACKNOWLDEGEMENTS: Research was funded by UKRI (EP/Z533415/1).

Declaration of Interest

(a) fully declare any financial or other potential conflict of interest

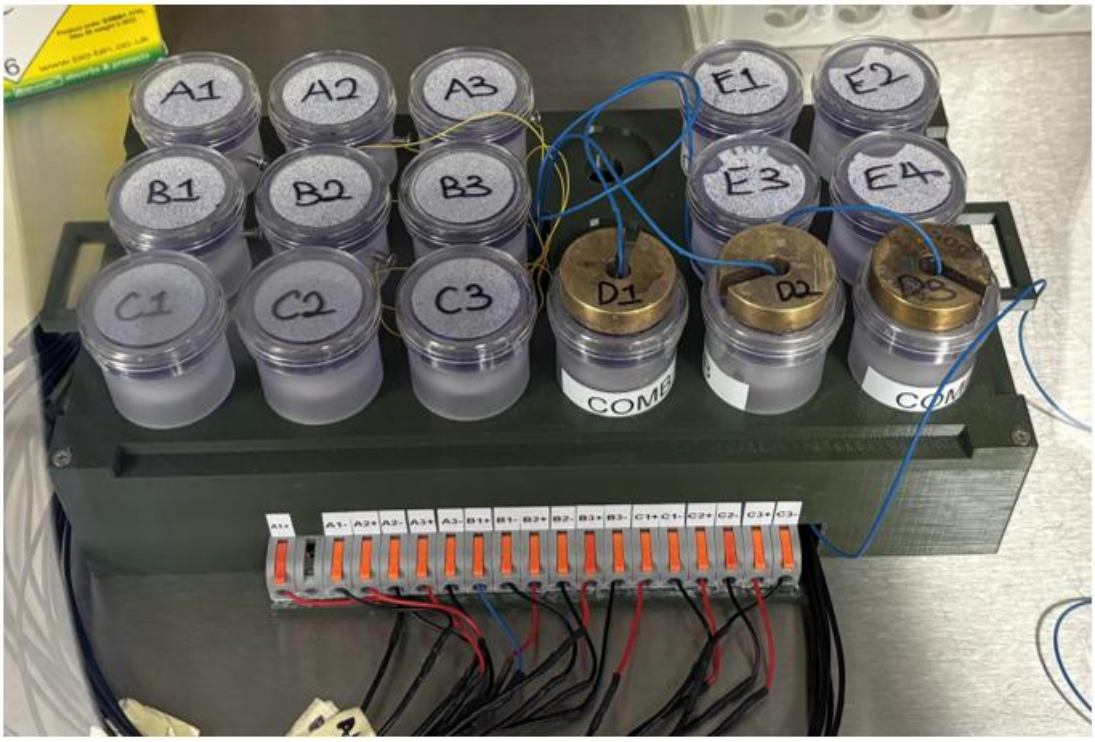

Figure 1. Custom-designed testing rig for delivering ultrasound to osteoblast-seeded implants in bioreactor chambers.

Assessing the bioactive profile of antifungal-loaded calcium sulphate against fungal biofilms

Mark Butcher[1], Jason Brown[2], Gordon Ramage[1]

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Abstract

Research Question: Despite representing less than 1% of prosthetic joint infections, fungal infections present a significant risk of revision and treatment failure and the landscape for improvement remains limited. The use of local mechanisms for release of antimicrobials, at the site of infection, can potentially alleviate some of this burden, particularly where vasculature and tissue integrity is compromised and systemic antimicrobials may be less effective. Here we developed an in-vitro model where Calcium Sulphate (CS) beads were mixed with amphotericin B, caspofungin, and fluconazole, to investigate their efficacy when introduced to clinically relevant fungi.

Methods: A panel of fungi (n=15) were selected for planktonic broth microdilution testing. After establishing planktonic susceptibility, antifungal CS beads were introduced to fungal biofilms (n=5) to assess biofilm formation and cell viability, through a combination of Crystal Violet and XTT assays. Inoculation of a hydrogel substrate, packed with antifungal CS beads, was used to assess diffusion through a semi-dry material, to mimic active infection in-vivo. This was assessed via Q-PCR and electron microscopy.

Results:Broth microdilution testing revealed sustained released of antimicrobials above established Minimum inhibitory concentrations (MIC) over a 7-day period. All antifungals were found to significantly impede growth of Candida species biofilms ($P < 0.0001$). Amphotericin B and caspofungin beads were observed to significantly reduced fungal biomass ($P < 0.0001$). A similar trend followed in assessment of hydrogels, with a reduction in colony forming equivalents when comparing CS beads loaded with caspofungin and amphotericin B across all organisms ($P < 0.001$). These findings were reflected in the electron micrograph imagery.

Conclusions: Our results have shown that antifungal loaded CS beads produce a sustained antimicrobial effect over 7 days, which inhibits clinically relevant

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Cam Deformity Cartilage as a Regenerative Cell Source: Biological Characterisation and Evaluation of Arthroscopic Harvest Techniques

Benjamin Woodhouse[1,2], Charlotte Hulme[1,2], Rajpal Nandra[2], Helen McCarthy[1,2], Jade Perry[1,2], Geraint Thomas[3,2], Karina Wright[1,2]

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Abstract

Introduction: Femoroacetabular impingement contributes to early hip osteoarthritis, with cam deformities causing cartilage damage. During arthroscopic correction, cam cartilage is routinely resected and discarded despite potentially containing viable chondrocytes. This study aimed to determine whether cam-derived cartilage contains comparable cells to paired non-cam cartilage and whether harvest techniques can recover viable tissue for intraoperative use.

Methods: In this retrospective ex vivo study, paired cam and non-cam cartilage was collected from femoral heads (n=18). Samples were graded macroscopically and histologically, and isolated chondrocytes were expanded to passage 2 and assessed for doubling time, flow cytometry, RT-qPCR, and sulphated glycosaminoglycan (GAG) content in native cartilage and chondrogenic pellet culture. Harvest technique was then evaluated in arthroplasty cartilage using scalpel, toothed shaver (AGGRESSIVE), and toothless shaver (RESECTOR), with 28-day assessment of viability, proliferation, GAG synthesis, cell density, tissue weight change, and explant colony-forming capacity.

Results: cam cartilage showed greater macroscopic degeneration than non-cam tissue (Collins:p=0.037; Modified-Outerbridge:p=0.048;ICRS:p=0.002), while histological scores were comparable. Native cartilage GAG was lower in cam tissue (37.05±8.92 vs 41.95±8.71 µg/mg;p<0.001), but chondrocyte density (p=0.325), doubling time (p=0.231), and pellet GAG/DNA synthesis (p=0.405) were similar. Cam-derived cells showed higher CD49a (p=0.009) and CD51/61 (p=0.024) immunopositivity, while COL2A1 expression was 1.9-fold lower (p=0.007). Harvest method significantly influenced outcomes: scalpel produced the highest viability versus shavers at all timepoints (p<0.05), population doubling time differed by method (p=0.021) and time (p<0.001), and GAG/mg, DNA, and GAG/DNA showed significant method-by-time interactions (all p<0.001). TOMCAT produced the highest explant colony number, scalpel the largest colonies, and RESECTOR showed intermediate performance.

Conclusion: Cam cartilage contains viable, comparable cells to non-cam tissue and represents an autologous cell source. Although shaver harvest reduced viability, shaver-derived tissue retained proliferative and matrix-forming capacity, supporting optimisation of harvest and delivery strategies for regenerative hip preservation.

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Healikick: Translational development of acellular and cellular approaches to bone grafting for non-union bone repair

Oihane Mitxelena Iribarren[1], Emma Muiños-López[2], Peter Childs[3], Leire Iturriaga Oñarte - Echevarria[1], Jonathan Williams[3], Diana Martínez[4], Monica Tsimbouri[5], Vineetha Jayawarna[5], Felipe Prosper Cardoso[2], Eva Gonzalez[4], Stuart Reid[3], Matthew Dalby[5], Froilan Granero Molto[2], Amaia Cipitria[1], Manuel Salmeron-Sanchez[5]

[1]Bio-Gipuzkoa, San Sebastián, Spain. [2]Universidad De Navarra, Navarra, Spain. [3]University of Strathclyde, Glasgow, United Kingdom. [4]Histocell SL, Bilbao, Spain. [5]University of Glasgow, Glasgow, United Kingdom

Abstract

Research Question: Non-union remains a significant clinical challenge, affecting up to 10% of fractures and often leading to recurrent surgeries. Current graft solutions include autograft, allograft, decellularised bone matrix, synthetic graft and high-dose growth factors, each with respective shortcomings. Atrophic non-unions are a core target for new, off-the-shelf graft materials, which can stimulate autograft levels of bone repair. The European funded Healikick project is testing complimentary cellular and acellular approaches to this challenge.

Methods: Two grafting strategies have been tested: HealiOst, a poly-ethyl acrylate (PEA) coated, monetite scaffold functionalised with fibronectin and BMP-2, and adipose-derived mesenchymal stromal cells (MSCs) which have been osteogenically primed with nanoscale vibration. Manufacturing translation has included establishment of industrial PEA coating and cGMP production of nanovibrated cells as final packaged products. Preclinical performance of each technology was assessed in rat critical-size defect models, and an ovine critical-size femoral defect model with µCT, histology, synchrotron imaging and nanoindentation.

Results: Data collected in rats demonstrates osteogenic response to low dose BMP-2 (10-25 µg/ml) with further improvements seen when delivered in combination with PEA and fibronectin. Bone bridging and bone volume around the monetite implants were both improved, showing seamless bone–monetite interfaces, bone infiltration and local mechanical/mineral properties approaching cortical bone. Testing of HealiOst and nanovibrated cells in an immunodeficient RNU rat model did not show improvements in bone bridging or bone volume. Osteogenic priming via nanovibration was validated in ovine adipose MSCs. Preliminary data from their implantation within the ovine model indicates higher levels of monetite turnover and increased bone formation compared to HealiOst, with and without BMP-2.

Conclusions: The Healikick project has increased translational readiness of cellular and acellular graft products in aspects of manufacture, preclinical evidence and commercial/regulatory awareness. The data supports future clinical translation of both technologies for non-union repair.

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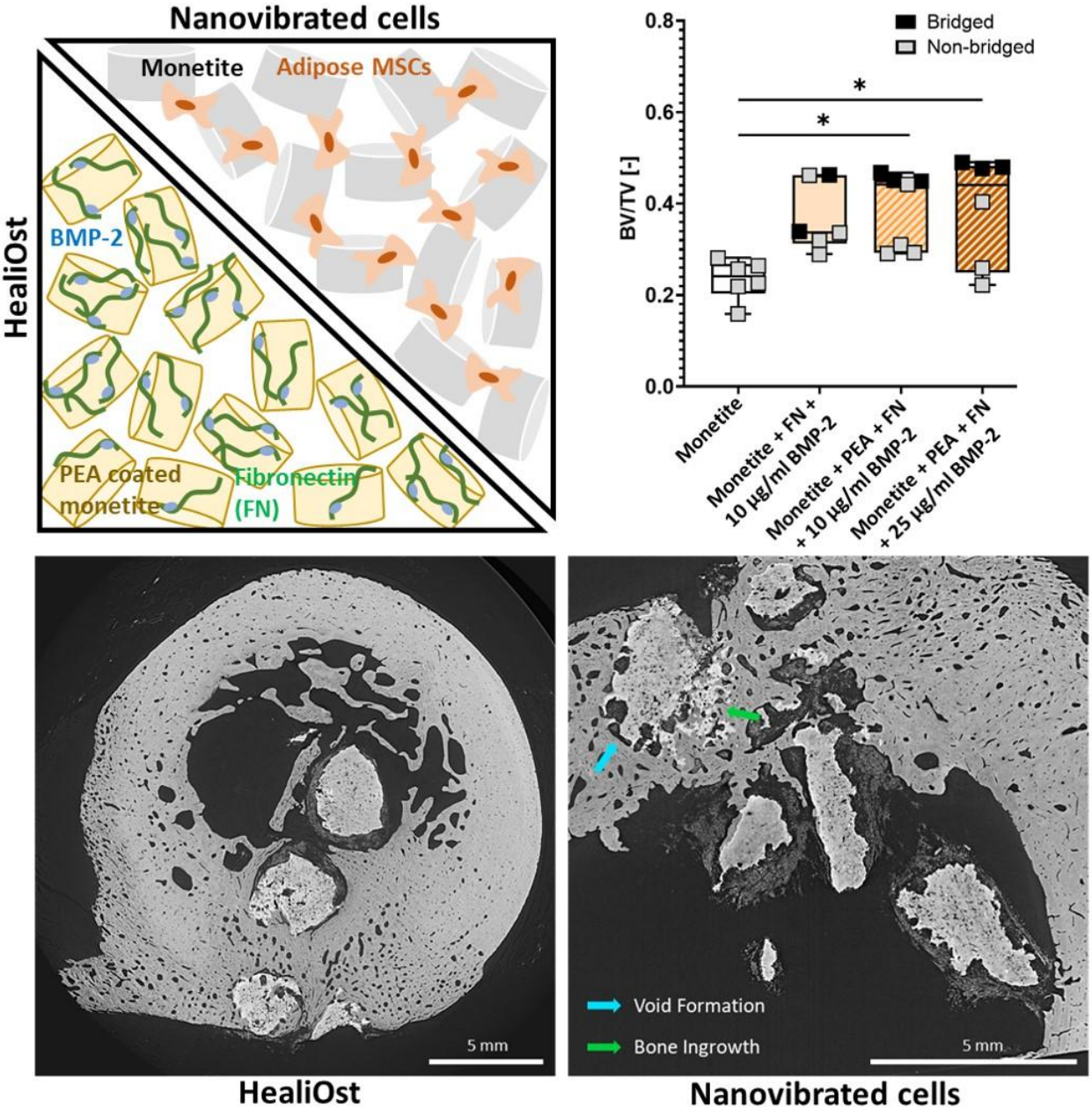
Nanovibrated cells
Monetite
Adipose MSCs
HealiOst
BMP-2
PEA coated monetite
Fibronectin (FN)
Bridged
Non-bridged
BV/TV [-]
0.0
0.2
0.4
0.6
0.8
*
*
Monetite
Monetite + FN + 10 µg/ml BMP-2
Monetite + PEA + FN + 10 µg/ml BMP-2
Monetite + PEA + FN + 25 µg/ml BMP-2
5 mm
Void Formation
Bone Ingrowth
5 mm
HealiOst
Nanovibrated cells

Poster Presentation Abstract

6

Sex and age affect progression to total knee arthroplasty after cartilage surgery - a UK Biobank cohort study.

Nicola J. Kuiper[1,2], Charlotte H. Hulme[1,2], Martyn Snow[1,3], Martin Frisher[4], Karina Wright[1,2], Jan Herman Kuiper[1,2]

[1]Oswestry/Keele Orthopaedic Research group, The Robert Jones & Agnes Hunt Orthopaedic Hospital NHS Foundation Trust, Oswestry, United Kingdom. [2]Centre for Science Technology and Medicine, School of Life Sciences, Keele University, Keele, United Kingdom. [3]The Royal Orthopaedic Hospital, Birmingham, United Kingdom. [4]School of Allied Health Professions & Pharmacy, Keele University, Keele, United Kingdom

Abstract

Research Question: To evaluate the association of sex and age at surgery with time to total knee arthroplasty (TKA) following knee cartilage surgery in UK Biobank (UKB) participants.

Methods: Participants (1967 males, 1741 females) with a history of knee cartilage surgery were classified into four surgical subgroups: cartilage repair, debridement, microfracture, and unicompartmental knee arthroplasty. Kaplan–Meier survival curves were used to analyse time from index surgery to primary TKA. Subgroup comparisons between sexes were assessed using the log-rank test. Cox proportional hazards regression was used to evaluate associations between age at surgery, sex, and surgery type with risk of progression to TKA.

Results: Log rank testing demonstrated significant sex based differences in time to TKA following debridement ($p = 0.002$) and microfracture ($p = 0.003$), with shorter TKA free survival observed in females. Cox regression showed that female sex was associated with a higher hazard of progression to TKA compared with male sex ($HR = 1.19$, $p = 0.021$). Increasing age at surgery was associated with increased risk ($HR = 1.05$ per year).

Conclusions: Female sex and older age at surgery were associated with a higher risk of progression to TKA following knee cartilage surgery. Sex specific differences in time to TKA were most evident after debridement and microfracture. These findings describe associations observed within the constraints of available UKB data.

Declaration of Interest

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A Novel ImageJ Macro for Quantitative Analysis of Toluidine Blue Staining in Cartilage Histology

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Abstract

Introduction: Toluidine-blue staining is widely used to assess cartilage matrix sulphated glycosaminoglycan content, but conventional ordinal grading is observer-dependent and poorly captures spatial heterogeneity. We developed a semi-automated ImageJ macro to provide objective, quantitative optical density (OD) analysis of toluidine-blue staining. This study aimed to evaluate its reproducibility, robustness, and ability to detect biologically relevant differences not identified by ordinal scoring.

Methods: Human osteochondral tissue was processed for paraffin histology, stained with 1% toluidine-blue, and imaged under standardised brightfield conditions. A custom ImageJ-JavaScript macro performed background-referenced white balance, grayscale conversion, manual cartilage region selection, and random non-overlapping tile sampling, generating up to 60-ROIs per image or 20-ROIs per cartilage zone. OD was calculated using the Beer-Lambert law. Reproducibility was assessed through repeated macro runs, analysis of degenerate cartilage, and sequential section analysis using variance testing, intraclass correlation coefficients, and Bland-Altman agreement.

Results: Repeated macro runs showed high reproducibility despite randomised ROI placement. Global-OD reproducibility was 98.5% and 97.5% in two representative donors, with no variance differences between runs ($p=0.900$ and $p=0.960$). Zonal reproducibility was similarly high, ranging from 87.1-99.9%. In degenerate cartilage, all samples yielded 60 valid ROIs, with OD values of 0.454±0.204, 0.621±0.320, and 0.398±0.216, supporting stable sampling despite marked tissue heterogeneity. Across sequential sections, global reproducibility was 82.8±13.7%, with low absolute OD differences and good-to-excellent reliability (ICC3=0.685;ICC3k=0.867). Reliability was strongest in the middle zone (ICC3=0.775;ICC3k=0.912), followed by the deep zone, while the superficial zone showed lower single-measure reliability that improved with averaging (ICC3=0.602; ICC3k=0.819). Bland-Altman analysis demonstrated minimal bias. Importantly, the macro detected significant global, middle, and deep zonal differences between two regions with identical ordinal scores (all $p<0.001$).

Conclusion: This workflow enables reproducible, quantitative assessment of toluidine blue staining and offers a more sensitive, objective alternative to conventional ordinal cartilage histology scoring.

Declaration of Interest

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Neutralisation of joint line obliquity improves early Oxford Knee Scores in valgus CPAK phenotypes after primary total knee arthroplasty

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Abstract

Research Question: The debate between kinematic and mechanical alignment (MA) centers on whether constitutional coronal plane alignment should be preserved or 'corrected.' Using the variability in Coronal Plane Alignment of the Knee (CPAK) changes following manual total knee arthroplasty (TKA), this study examined whether changes in CPAK were associated with patient-reported outcomes for different constitutional phenotypes.

Methods: A retrospective cohort of 1,000 manual cemented MA TKAs was assessed, with 621 included for analysis. Knees were grouped by constitutional CPAK phenotype. Multivariable regression assessed the associations of postoperative changes in CPAK, arithmetic hip-knee-ankle angle (aHKA), and joint line obliquity (JLO) categories, and their deltas (Δ), with Oxford Knee Scores (OKS) and satisfaction at 6 weeks and 1 year.

Results: Overall, changing CPAK phenotype was associated with a higher 6-week OKS (β 1.97, 95% CI 0.24 to 3.71, P = 0.026) and increased odds of satisfaction at 1-year (OR 2.84, 95% CI 1.10 to 6.80, P = 0.023). In constitutional CPAK III knees, changing JLO category (β 4.19, 95% CI 0.02 to 8.36, P = 0.049) and increasing ΔJLO (β 0.49, 95% CI 0.02 to 0.97, P = 0.041) were associated with a higher 6-week OKS. Similarly, in CPAK VI knees, increasing ΔJLO (β 1.10, 95% CI 0.35 to 1.85, P = 0.005) was associated with a higher 6-week OKS. Conversely, CPAK V knees demonstrated a lower 1-year OKS with increasing ΔJLO (β -1.13, 95% CI -2.13 to -0.14, P = 0.026).

Conclusions: Although changing CPAK phenotype was associated with superior early outcomes overall, this was primarily driven by valgus phenotypes (CPAK III and VI) benefitting from JLO neutralisation. In contrast, CPAK V knees performed worse with an apex proximal shift. These findings suggest universal TKA alignment strategies may not be optimal, warranting stratified analyses to define phenotype-specific targets.

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Population-scale computational biomechanics of the knee: A systematic review of Statistical Shape Modelling and simulation

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Abstract

Research Question: How does native knee morphology, assessed using population-scale statistical shape modelling (SSM) and computational simulation, independently influence joint contact mechanics and the risk of pathology?

Methods: A systematic review was conducted in accordance with PRISMA guidelines. We included primary studies utilising SSM paired with physics-based computational simulations (Finite Element Analysis or musculoskeletal modelling) of the native knee. Purely morphological, in-vitro experimental, and arthroplasty-focused studies were excluded to isolate native joint mechanics. Data extracted included simulation modality, anatomical focus, and quantitative biomechanical outcomes (e.g., contact pressure, ligamentous force).

Results: Following rigorous screening, 12 high-quality computational studies were included. The literature focused on two distinct clinical domains: sports biomechanics (patellofemoral instability, ACL kinematics) and degenerative joint disease (osteoarthritis, post-meniscectomy mechanics). The aggregated data demonstrated that population-level geometric variations—specifically features like trochlear groove depth, lateral tibial plateau slope, and patellar apex morphology—significantly and predictably alter compartmental contact pressures and ligament load distributions. Crucially, these SSM-driven simulations quantified that native joint shape acts as an independent biomechanical risk factor for elevated joint stress, distinct from overall joint size or gross mechanical alignment.

Conclusions: Integrating SSM with computational biomechanics provides a rigorous mathematical framework for evaluating knee morphology. Native shape variation is a distinctly quantifiable driver of joint stress. Simulating these morphological phenotypes in silico offers powerful predictive data to optimise personalised interventions, such as tibial tubercle osteotomies, and to accurately assess long-term osteoarthritis risk.

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Scapular Fracture Surgery at a Tertiary Shoulder Centre: Indications, Fixation Strategy, and Clinical Outcomes

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Abstract

Research Question: Scapula fracture fixation is rare and often complex, necessitating a tailored approach. In a tertiary shoulder unit, we have previously found that a high proportion of fractures require accessory or linking plates, in adjunct to medial and lateral plates, to achieve stability. Our aim is to review our current practice.

Methods: Patients who underwent scapula fixation from 2020-2025 in a single tertiary trauma centre were retrospectively analysed. Demographics, mechanism of injury, pre-operative imaging, surgical technique, outcomes including range of movements, return to work, radiological union and complications were analysed.

Results: 19 patients underwent scapula fixation for trauma. High energy mechanisms were responsible for all cases, with a mean age 44.7. Indications were intra-articular extension into the glenoid (53%, n=10), reduced glenopolar angle (32%, n=6), medialisation of the glenoid (21%, n=4) and floating shoulder (16%, n=3). Extensile Judet approach with a medial “hockey stick” and lateral plates were used in 95%(n=18) of cases. 74%(n=14) required an additional linking plate to achieve stability. To achieve this, a single clavicle plate was used in 58% (n=11) of cases and 2 plates in 16% (n=3) of cases. Mean follow up time was 25 months. Functional outcome at one year was excellent. 87.5% (n=14) patients returned to work, 50% (n=8) returned to full pre-morbid activities and 100% (n=16) were independent of ADLs. Radiographic union was achieved in 100% of cases. Post-traumatic arthritis was radiographically evident in 3 patients. Further surgery was required in 3 patients(19%) for removal of metal(n=2) and infection(n=1).

Conclusions: Scapula fracture fixation can be complex and often necessitates additional stability beyond medial and lateral fixation alone. A linked plating strategy provides reliable union and favourable functional outcomes. Future scapular fixation system designs may benefit from incorporating an integrated linking plate concept to enhance construct stability.

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Development of national guidance for people waiting for total hip and knee replacement surgery in Scotland: The Waiting Well project

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Abstract

Research Question: How should people be supported while they are waiting for total hip or knee replacement surgery in Scotland?

Methods: A programme comprising four work packages was undertaken, to produce guidance and audit standards for use across Scotland. Work package 1: JBI scoping review (417 included reports) followed by three contingent reviews: (i) economic evidence (9 studies), (ii) qualitative evidence (28 studies), (iii) review of reviews (75 systematic reviews). Work package 2: National survey of current services provided for people waiting for total hip or knee replacement surgery (16 Health Boards), alongside desktop analysis of public-facing information. Work package 3: Three-round modified Delphi study (47 participants) to reach consensus on how to support people waiting for total hip or knee replacement surgery. Work package 4: Development of national guidance using SIGN rapid guideline development methodology, via a guidance development group (n=26) participating in four online workshops over a 9-month period.

Results: Work package 1 identified existing and generated new high-quality evidence on effectiveness, cost-effectiveness, feasibility and acceptability of pre-operative education, exercise-based prehabilitation, patient optimisation, and support for people waiting a long time for surgery. Work package 2 highlighted variability in service provision across Scotland. These findings informed the first round of the Delphi study (Work package 3), which generated 108 recommendations that were grouped into domains and used to develop eight key questions for consideration by the guidance development group (Work package 4). The final guidance comprises six recommendations (three strong; three conditional) on: content and format of pre-operative education (n=3); exercise-based prehabilitation; optimisation; and support during extended waiting times.

Conclusions: Evidence-based national guidance has been developed by an expert multidisciplinary group using robust methodology to support people waiting for hip and knee replacement surgery in Scotland. Its implementation should be evaluated to assess uptake, feasibility and patient benefit.

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Public Health Scotland

6 Recommendations for patients waiting for hip & knee replacement surgery in Scotland

1 Pre-operative Education (format)

Useful ways to deliver education include...

- Written materials
- Digital resources
- In person or online group sessions

To help patients understand what to expect and support decision making

2 Pre-operative Education (content)

Should include information on...

- The operation & anaesthetic options
- Preparing for surgery
- Managing pain and anxiety
- Hospital processes
- Practical arrangements (home, work)
- Self management & goal setting

3 Post-operative Education (content)

Information around recovery should include...

- Pain & swelling management
- Early movement, exercise guidance
- Wound care & infection signs
- Recovery milestones
- Follow-up appointments, support services

4 Prehabilitation: Exercises

Pre-surgery prehabilitation programmes could be considered.
These programmes might include...

- Strength training
- Aerobic activity
- Flexibility exercises
- Balance training
- Functional movement practice

These can be delivered in the home, in the community, online or in person.

5 Prehabilitation: Optimisation

Ways to improve health could be considered. Support might include...

- Medical checks and optimisation.
- Healthy lifestyle advice.
- Education and behavioural support.

6 Waiting a long time for surgery

For people waiting a long time for surgery, services should consider offering...

- Information on how waiting lists are managed
- Regular communication updates
- A contact point for questions or to report changes in condition

Strong recommendation: good evidence and strong agreement among clinicians and patients.

Conditional recommendation: some uncertainty in evidence but likely beneficial and minimal risk of harm.

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Evaluating the primary functional and mechanical data that informs the concepts of ankle instability: A Scoping review

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Abstract

Introduction: Understanding of chronic ankle instability (CAI) has evolved from a dichotomous view of mechanical versus functional ankle instability to a systems-based model recognising the interconnected nature of both issues. However, it is unclear to what extent primary mechanical and functional stability data have established this relationship and informed the development of the conceptual models.

Methods: Structured systematic scoping review as per PRISMA-ScR criteria. Five databases (AMED, SPORTDiscus, CINAHL Ultimate, Web of Science, and MEDLINE) were searched without date restrictions using multiple search clusters with MeSH headings and Boolean operators. Studies were included if they reported objective measurement of both mechanical and functional ankle instability parameters in individuals with recurrent ankle sprains. Screening and data extraction were performed by two independent reviewers.

Results: From 1,314 screened studies, nine met the inclusion criteria, comprising 197 participants (90/107 male/female, aged 25.2±8.0 years) with CAI and 133 (58/75 male/female, aged 24.1±6.3 years) controls. Assessment approaches and methodologies were highly heterogeneous across studies. Three studies used ultrasound (+/- MRI) alongside force plate or balance testing to link ligament structure with postural control. Two studies combined ultrasound or MRI with motion capture systems to evaluate dynamic ankle mechanics during gait. Two others used MRI or arthrometry with force plate, balance, or pedobarography measures to connect ligament laxity with functional deficits. The remaining studies integrated radiography, CT, MRI, or arthroscopy with force plate, motion capture, and dynamometry for comprehensive evaluation.

Conclusion: The conceptual understanding of CAI is supported by primary data from only 9 studies that have simultaneously evaluated both mechanical and functional impairments using objective measures. The variability in assessment and small sample sizes restricts comparability and limits insight into the interaction between structural and functional deficits. Future research should adopt standardised methodologies combining advanced imaging with comprehensive biomechanical and neuromuscular assessments.

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Nanovibrational stimulation for mesenchymal stromal cell osteogenesis: investigating the relationship between osteogenesis and inflammation

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Abstract

Bone anomalies pose a global burden, emphasizing the need for improved understanding of bone biomechanics, pathophysiology, and regenerative strategies. Conventional bone tissue engineering relies on exogenous agents, such as growth factors (BMP2) and corticosteroids (dexamethasone), to promote osteogenesis, but these have limitations, including poor differentiation specificity and side effects. We developed a nanovibrational bioreactor capable of inducing mesenchymal stem cell (MSC) osteogenesis using 30 nm amplitude, 1 kHz stimulation (NK30) without chemical supplementation. Therefore, we investigate the effects of high-amplitude nanovibration (100 nm, NK100, 1 kHz) on MSC osteogenesis, redox balance, and inflammatory pathways. To address this, human bone marrow-derived primary MSCs (hBMSCs) were cultured at NK30 and NK100 with osteogenic media (OGM), basal control, and stress conditions (10 µM TBHP, 0.1 µM Doxorubicin) for 4 and 6 weeks. In-cell western was performed to quantify phospho-p38/p38 ratio, osteopontin (OPN), and osteocalcin (OCN) protein expression. Late-stage matrix mineralization was determined by Von Kossa staining. Flow cytometry was used to analyse total ROS production, while in-cell western assessed protein expression of glutathione reductase (GSR), superoxide dismutase 1 (SOD1), and catalase. DNA damage was determined based on ϒH2AX-foci count using immunostaining. TOM20 expression was examined using in-cell western. Secretory profiling of inflammatory cytokines (IL-6, TNF-α, IL-8, and TGF-β1) was performed using ELISA. Our findings suggest that high-amplitude nanovibrational stimulation may promote enhanced MSC osteogenesis, likely under eustress or mild physiological stress and optimal inflammatory conditions, as supported by an increased phospho-p38/p38 ratio, OPN, and OCN protein expression, considerable late-stage matrix mineralisation, optimal total ROS production, a gradual decrease in TOM20 expression, and moderate expression levels of GSR, SOD1, and catalase. This was further reflected in fewer ϒH2AX-foci count and non-significant secretion of pro-inflammatory cytokines, IL-6, TNF-α, IL-8, and anti-inflammatory cytokine, TGF-β1. Future transcriptomic analysis will define molecular mechanisms governing nanovibrationally enhanced osteogenesis.

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Efficacy and Safety of Gabapentinoids in Total Hip and Knee Replacement: A Systematic Review

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Abstract

Research Question: Total joint arthroplasty involves significant tissue trauma and is consistently associated with moderate to severe acute postoperative pain. While gabapentinoids have been widely incorporated into multimodal Enhanced Recovery After Surgery (ERAS) pathways as opioid-sparing adjuncts, recent literature questions their risk-benefit ratio [1, 2]. This systematic review evaluates the contemporary evidence regarding the efficacy and safety of perioperative gabapentin and pregabalin in adults undergoing total knee and/or hip arthroplasty (TKA/THA).

Methods: A systematic review was conducted in accordance with PRISMA guidelines [3]. Four electronic databases (PubMed, Cochrane Library, Embase, and Scopus) were searched for randomized controlled trials (RCTs) published from 2016 onward. Eligible studies compared perioperative gabapentin or pregabalin against standard care or placebo in adults undergoing TKA and/or THA.

Results: Seven RCTs comprising 913 patients met the inclusion criteria. The aggregated data demonstrate that routine administration of gabapentin or pregabalin yields inconsistent and largely non-clinically significant improvements in acute postoperative pain and opioid consumption. Furthermore, the evidence indicates no sustained long-term benefits regarding functional recovery, psychological well-being, or the prevention of chronic postsurgical pain. While serious adverse events were absent across the included cohorts, the anticipated analgesic benefits were not reliably reproduced.

Conclusion: Contemporary RCT data do not support the routine perioperative administration of gabapentin or pregabalin for patients undergoing TKA or THA. Given the lack of consistent, clinically meaningful reductions in acute pain and opioid consumption, modern ERAS pathways should pivot away from blanket gabapentinoid inclusion and focus on individualized administration for high-risk patient phenotypes.

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Use of wearable sensors to assess bone-relevant mechanical loading: current limitations and future directions.

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Abstract

Research Question: Mechanical loading is a key regulator of bone in preclinical models, but its effects in human populations are less well defined. Although wearable sensors may estimate mechanical loading during daily activities, their relationship with bone health outcomes is unclear. This scoping review examined wearable sensor–based approaches to assessing mechanical loading in adult humans.

Methods: This review included studies involving adult human participants that used body-worn wearable sensors to assess mechanical loading during dynamic or weight-bearing activities in relation to bone health. A targeted search was conducted across three databases (MEDLINE, EMBASE, CENTRAL) using keywords related to wearable technologies, mechanical loading and bone health outcomes, including bone mineral density. Studies were screened at the title and abstract level, with full texts assessed for eligibility. Data on study design, sensor type, loading measures and bone health outcomes were extracted and synthesised descriptively.

Results: Of the 64 studies screened, 24 met the inclusion criteria. Most were observational or cross-sectional and used accelerometers or inertial measurement units to characterise loading through acceleration- or gait-based measures, with bone outcomes most commonly assessed using DXA. The majority of studies focused on gait analysis, rehabilitation or methodological validation, while relatively few directly assessed bone health or attempted to quantify skeletal loading beyond exposure to weight-bearing or impact exercise and no study directly quantified bone-relevant mechanical dose using wearable sensors or established a dose–response relationship.

Conclusions: Wearable sensors are widely used to assess movement and physical activity but are rarely applied to quantify bone-relevant mechanical loading in a manner that informs bone health outcomes. This finding limits their clinical application in personalising interventions to improve bone health and requires future investigations.

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Embedding of a Biomedical Engineer into a Tertiary Orthopaedic Unit - Case Studies and Impact Assessment

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Abstract

Research Question: Does embedding a biomedical engineer (BME) within an orthopaedic department accelerate translational innovation and reduce reliance on outsourced services?

Methods: Practice-based service evaluation of the first phase of an embedded BME working across clinical observation, theatre attendance, MDT meetings, and project development with multidisciplinary stakeholders. Notes, project logs, stakeholder interviews, and cost comparison against outsourced design services were analysed to identify enablers, barriers, and indicators of translational value.

Results: We present archetypical use cases where the BME supported >20 orthopaedic cases requiring 3D digital visualisation, planning or anatomical model printing. Establishing an in-house 3D planning and printing hub can reduce per-case costs from outsourced rates of £2,000–£3,000 (2–6-week lead time) to approximately £1,000 per case at scale, while delivering models in 3–5 days; transforming a logistical vulnerability into a strategic asset. Significant additional benefits include continuous quality improvement and an infrastructure fostering exploration and adoption of innovative clinical practice which improves surgical accuracy leading to reduced rates of revision. The service also generated an award-winning poster on 3D printing of patient-specific anatomy for pre-surgical simulation. Stakeholders identified the principal hurdles to integration as administrative rather than technical—long-term funding, integration routes, and access to data and facilities. Impact was mapped across four domains: clinical (time saved, accuracy, complications, revisions); service (cases supported, turnaround, savings); and cultural (clinician-reported confidence). Ready clinical access improved problem–method matching, while informal interactions surfaced pathway inefficiencies and device-usability issues not raised in scheduled meetings.

Conclusions: Embedding a BME within an orthopaedic department is a practical translational model that supports clinically grounded innovation and more implementable research. Success depends on clear expectations, visible sponsorship and clinical access. The trials and tribulations of embedding are not weaknesses but the conditions through which meaningful translational orthopaedic research is produced.

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Genetic determinants of anterior cruciate ligament rupture in females: a systematic review with implications for risk stratification and prevention

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Abstract

Research Question: Females sustain anterior cruciate ligament (ACL) ruptures at higher rates than males, yet genetic susceptibility has largely been studied in mixed-sex cohorts, potentially obscuring female-specific effects. This study aimed to synthesise and critically appraise female-specific genetic associations with ACL rupture.

Methods: A PRISMA 2020–guided systematic review was conducted with protocol registration on the Open Science Framework. Four databases were searched from inception to 21 December 2025. Eligible studies included human genetic association studies reporting female-specific ACL rupture outcomes or extractable female-only data. Due to heterogeneity in study design, populations, phenotypes and genetic models, findings were synthesised narratively. Risk of bias was assessed using the Newcastle–Ottawa Scale.

Results: Nineteen studies met inclusion criteria, comprising one prospective cohort, one retrospective cohort and seventeen candidate-gene case–control studies. No female-specific genome-wide association studies were identified. The most consistent evidence was observed for *COL5A1*, particularly rs12722, with multiple cohorts demonstrating under-representation of the CC genotype or C allele among ACL-injured females, suggesting a modest protective association. Evidence for other collagen, extracellular matrix, inflammatory and matrix remodelling genes was inconsistent, population-specific and largely derived from underpowered single cohorts.

Conclusions: Female-specific genetic evidence for ACL rupture susceptibility remains limited. *COL5A1* rs12722 is the most consistently replicated association; however, effect sizes are modest and do not support clinical genetic screening or risk stratification. The absence of female-specific genome-wide studies represents a critical translational gap.

Declaration of Interest

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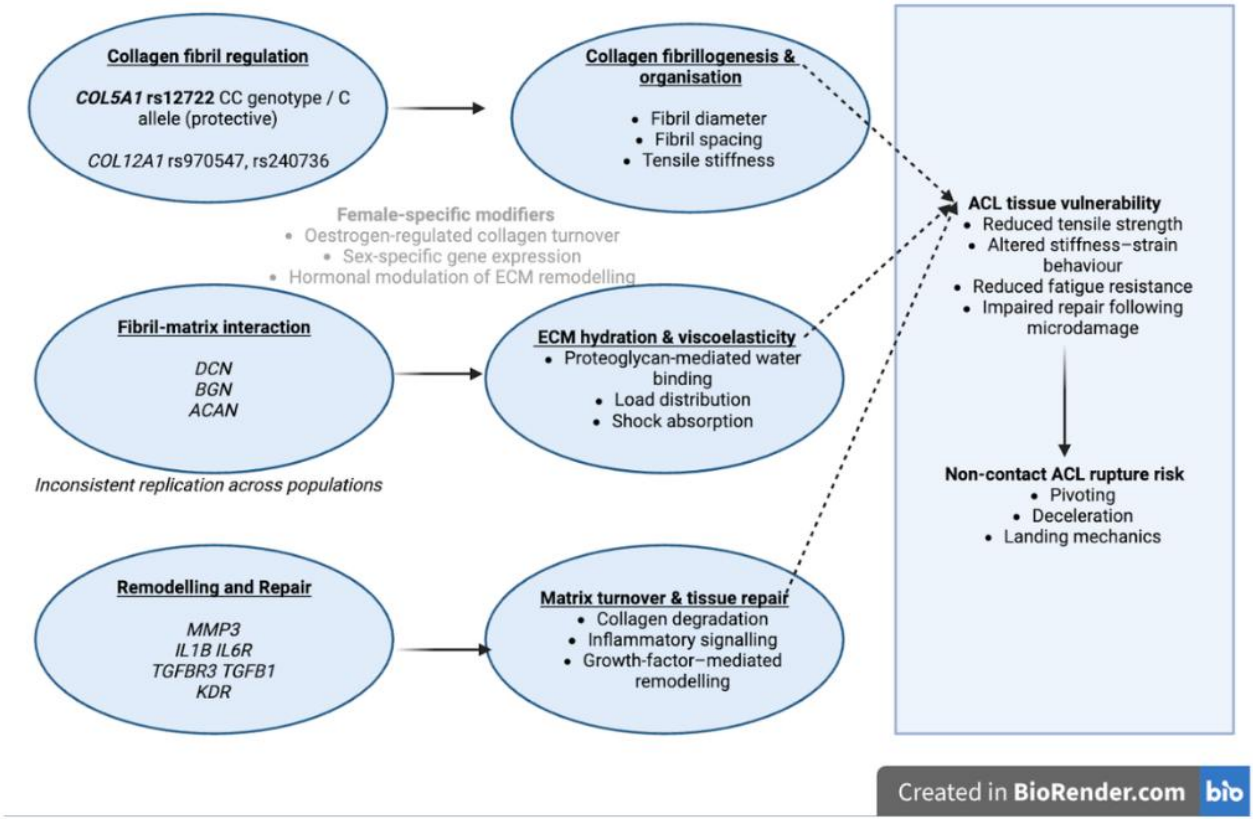
Collagen fibril regulation
COL5A1 rs12722 CC genotype / C allele (protective)
COL12A1 rs970547, rs240736
Collagen fibrillogenesis & organisation
Fibril diameter
Fibril spacing
Tensile stiffness
Female-specific modifiers
Oestrogen-regulated collagen turnover
Sex-specific gene expression
Hormonal modulation of ECM remodelling
Fibril-matrix interaction
DCN
BGN
ACAN
Inconsistent replication across populations
ECM hydration & viscoelasticity
Proteoglycan-mediated water binding
Load distribution
Shock absorption
Remodelling and Repair
MMP3
IL1B IL6R
TGFBR3 TGFB1
KDR
Matrix turnover & tissue repair
Collagen degradation
Inflammatory signalling
Growth-factor–mediated remodelling
ACL tissue vulnerability
Reduced tensile strength
Altered stiffness–strain behaviour
Reduced fatigue resistance
Impaired repair following microdamage
Non-contact ACL rupture risk
Pivoting
Deceleration
Landing mechanics
Created in BioRender.com

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The Pull-Out Strength of Lateral Extra-Articular Tenodesis: A Biomechanical Cadaveric Study

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Abstract

Research Question: Lateral extra-articular tenodesis (LET) is performed alongside anterior cruciate ligament (ACL) reconstruction to reduce anterolateral rotational instability and graft failure risk. Identifying the optimal fixation technique requires a reproducible model reflecting combined translational and rotational loading. This study evaluates the feasibility of a cadaveric biomechanical protocol for assessing 20 mm ligament staple fixation.

Methods: Five fresh-frozen cadaveric knees were mounted in a custom-built jig allowing three-axis alignment on an Instron universal testing machine. Soft tissues were removed to isolate the iliotibial band (ITB) and lateral collateral ligament (LCL), while the ACL and posterior capsule were preserved during mounting to maintain alignment. The ITB was passed deep to the LCL and fixed to the femur using a 20 mm staple. Following alignment, the ACL and posterior capsule were sectioned. The tibia was embedded in casting resin within a plastic mould and reinforced with a bolt. The proximal femur was secured to the Instron grips using a plate-and-bolt construct. Specimens underwent tensile preconditioning for 2 minutes at 2 Hz between 50 and 120 N, followed by displacement-controlled loading at 20 mm/s with internal rotation at 30°/s to failure. Total displacement combined vertical machine and rotational displacement. Failure mechanism, ultimate load, displacement and stiffness were recorded.

Results: Testing was completed in five specimens. Mean peak load to failure was 0.92 kN (SD 0.25), mean displacement at peak force was 26.55 mm (SD 5.2), and mean stiffness was 37.93 N/mm (SD 8.88). Failure mechanisms were staple–ligament interface failure (n=3) and ligament pull-through without rupture (n=2).

Conclusions: This protocol feasibly evaluated LET fixation under combined translational and rotational loading. Failure load exceeded Tollefson et al.'s reported staple value of 151.8 N (SD 34.1), potentially reflecting the 60x higher loading rate adopted in the current study.

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Revision Risk Following Computer-Navigated Versus Conventional Total Hip, Total Knee, and Unicompartmental Knee Arthroplasty: A Meta-Analysis of Global Registry and Administrative Datasets

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Abstract

Background: Computer navigation in hip and knee arthroplasty aims to improve implant positioning and reduce revision risk, but its clinical value remains debated due to underpowered individual studies. This meta-analysis compared computer-navigated versus conventional instrumentation for total hip (THR), total knee (TKR), and unicompartmental knee replacement (UKR) to determine the impact on all-cause revision risk and, specifically for THR, the risk of revision due to dislocation.

Methods: Databases were searched from inception to 7th January 2026. Comparative observational studies using national arthroplasty registries or nationwide administrative databases were eligible. Primary outcomes were all-cause revision following THR, TKR, and UKR, as well as revision for dislocation after THR. Random effects multilevel meta-analysis was performed using adjusted hazard ratios (HR).

Results: 7 THR, 9 TKR, and 3 UKR studies were eligible for inclusion. Mean/median follow-up ranged from 3.76-8.43 years (THR), 5.0-6.34 years (TKR), and ≥2 years (UKR). For THR, pooled analysis showed no difference in all-cause revision (HR 0.96, 95% CI 0.77 to 1.21, p=0.754; n=27,080 navigated/n=478,355 conventional) or revision for dislocation (HR 0.82, 95% CI 0.46 to 1.45, p=0.485; n=18,902 navigated/n=310,884 conventional). For TKR, computer navigation was associated with a marginal reduction in all-cause revision (HR 0.96, 95% CI 0.93 to 0.99, p=0.013; n=208,531 navigated/n=619,497 conventional). For UKR, no difference was observed between groups (HR 1.00, 95% CI 0.79 to 1.27, p=0.991; n=1,177 navigated/n=40,649 conventional).

Conclusions: Computer navigation was not associated with clinically meaningful reductions in revision risk for THR, TKR, or UKR. While a marginal statistical improvement was observed for TKR over the follow-up period, this may not be justified by the increased costs of computer navigation. Despite being the largest meta-analysis on this topic, uncertainty remains regarding the effects of navigation on revision following THR and UKR due to limited sample sizes.

Declaration of Interest

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A comparison of the properties of Mesenchymal Stem Cells derived from different synovial sources: a systematic review

Moiz Ahmad[1], Jazvir Kapoor[1], Chanuth Wilegoda[1], Max Liu[1], Wasim Khan[2]

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Abstract

Introduction: Mesenchymal stem cells (MSCs) are capable of self-renewal and can differentiate into different cellular lineages like osteocytes, chondrocytes and adipocytes. This makes them a strong candidate for repairing degenerative joint conditions like osteoarthritis, where native cartilage lacks intrinsic repair capacity. Synovial MSCs have been shown to have superior proliferative and chondrogenic potential compared to other MSC sources like bone marrow and adipose tissue. However, the synovial joint is a heterogenous environment and MSCs can be derived from synovial fluid (SF), membrane (SM) and within membrane, different anatomical regions and histological subtypes of fibrous and adipose synovium (FS and AS). Any source-dependent variation in properties could impact the efficacy of cell-based regenerative treatments. The objective of this review is thus to systematically compare the properties of MSCs derived from different synovial sources.

Methodology: A systematic review was conducted and reported according to PRISMA guidelines. 10 human studies of donor-matched synovial MSCs met the inclusion criteria after full-text screening, spanning three comparison domains: SF vs SM, FS vs AS and regional variation within SM. Extracted outcomes included proliferative characteristics, immunophenotype and differentiation potential. Heterogeneity excluded formal meta-analysis and so a narrative synthesis of results was conducted. Risk of bias was assessed using the OHAT tool.

Results: SM-MSCs had superior or comparable proliferative characteristics compared to SF-MSCs, whilst differences in immunophenotype and differentiation potential were not significant or inconsistent. There was conflicting evidence regarding differences in properties of FS and AS-MSCs, especially proliferative and differentiation potential. SM-derived MSC properties varied with harvest site, with proximity to vasculature appearing to correlate with differentiation and proliferation potential.

Conclusion: Synovial MSCs show significant source-dependent variation in properties including proliferation, differentiation and immunophenotype. The local microenvironment is likely a key determinant of the properties of these MSCs, with vascular proximity in particular appearing to affect MSC characteristics.

Declaration of Interest

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Sternoclavicular Joint Stabilisation: Surgical Strategies and Clinical Outcomes

Jordan Bethel, Sani Magaji, Eshan Oderuth, Oliver Mase, David Thyagarajan

Northern General Hospital, Sheffield, United Kingdom

Abstract

Research Question: Surgical stabilisation of the sternoclavicular joint (SCJ) is rarely required but may be indicated in persistent, symptomatic instability following failed non-operative management. Anterior dislocation is most common. Posterior stabilisation carries greater risk due to the proximity of vital mediastinal structures. Owing to the rarity of these injuries, published outcome data remain limited.

Methods: This study presents a retrospective review of prospectively collected data, supplemented by operative record analysis from the Operating Room Management Information System (Oracle, CA, USA). Between 2017 and 2025, 20 patients underwent SCJ stabilisation for painful instability, including three revision referrals with persistent symptoms following surgery elsewhere. All patients underwent preoperative CT or MRI imaging and received detailed counselling regarding risks and expected outcomes.

Results: Twelve patients presented with anterior instability and six with posterior instability, including one case of a “floating clavicle” requiring stabilisation at both the medial and lateral ends. Among the posterior instability cases, three were acute traumatic dislocations, two were chronic dislocations presenting at 6 months and 2 years following injury, and one was a recurrent posterior subluxation in a patient with underlying ligamentous laxity. Concomitant osteoarthritis was identified in 16% of patients. All procedures utilised a prosthetic ligament reconstruction. Our technique for SCJ stabilisation employs a woven, multifilament, high-tenacity polyethylene terephthalate device (Poly-Tape, Xiros®), using a modified docking technique between the sternum and the medial clavicle. Further technical aspects will be described. Functional outcomes were assessed using validated shoulder scores and return to occupational and sporting activity was recorded. The mean age was 43.5 years. Mean follow-up was 19 months. Minor scar sensitivity was reported in nine patients. There were no cases of recurrent instability or requirement for revision surgery.

Conclusion: SCJ stabilisation using prosthetic ligament reconstruction provides reliable stability and favourable functional outcomes in this challenging and uncommon condition.

Declaration of Interest

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Surgical Management of Sternoclavicular Joint Disorders: 10-Year Experience at a Tertiary Referral Centre

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Sheffield Teaching Hospitals NHS Trust, Sheffield, United Kingdom

Abstract

Introduction: Sternoclavicular joint (SCJ) pathology is uncommon and may result in significant pain, instability and functional impairment. Surgical intervention is technically demanding, given the joint's proximity to vital mediastinal structures. Robust long-term institutional data remains limited.Aim: To evaluate a decade of SCJ surgery at a tertiary referral centre, analysing indications, operative strategies, complications, functional outcomes and return to work and sport.

Methods: A retrospective review was performed of all patients undergoing SCJ surgery between 2015 and 2025. Demographics, comorbidity indices, surgical indications, procedure type, complications, and reoperations were recorded. Functional outcomes were assessed using validated shoulder scores. Return to occupational and sporting activity was documented.

Results: 34 patients underwent surgery. Indications were instability (20), osteoarthritis (11), septic arthritis (2) and SAPHO syndrome (1).Instability cohort: The mean age was 43.5 years. Anterior instability (12) was more common than posterior instability (6). Posterior instability cases included 3 acute traumatic dislocations, 2 chronic dislocations presenting at 6 months and 2 years post-injury, and 1 recurrent posterior subluxation in a patient with ligamentous laxity. 2 patients had persistent instability following previous SCJ surgery done elsewhere. Concomitant osteoarthritis was present in 16%. At a mean follow-up of 19 months, 9 patients reported minor scar sensitivity. There were no cases of persistent instability or revision surgery. Arthritis cohort: Twelve patients underwent excision arthroplasty for symptomatic osteoarthritis (10) and infection (2). The mean age was 57.4 years. At 10.8 months (range 12-36) mean follow-up, 2 patients reported minor scar sensitivity. No major complications or revisions occurred.

Conclusions: SCJ surgery demonstrated favourable functional outcomes, universal return to work and high rates of return to sport. Instability remains the leading indication. With careful patient selection and meticulous technique, reliable and reproducible outcomes can be achieved in this anatomically complex region.

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Sclerostin as a biomarker and therapeutic target in spinal cord injury-induced bone loss: a scoping review

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Abstract

Research Question: What evidence exists for sclerostin as a biomarker and therapeutic target in spinal cord injury (SCI)-induced bone loss?

Methods: PubMed (MEDLINE), Embase and Cochrane CENTRAL were searched in April 2026 using terms for spinal cord injury, bone or osteoporosis, and sclerostin, SOST, or romosozumab. Eligibility followed the PCC framework: population was SCI populations and preclinical SCI models; concept was sclerostin as a biomarker or therapeutic target; context was SCI-induced bone loss in any preclinical or clinical setting.

Results: Identified 344 records, 38 met inclusion criteria. After excluding, 12 review articles and 26 original articles were included, comprising 12 preclinical in vivo studies (46%), 7 clinical observational studies (27%), 6 clinical trials (23%), and one *in vitro* study (4%). As a biomarker, sclerostin has been shown to suppress bone formation via the Wnt/β-catenin pathway in preclinical models. In clinical studies, sclerostin was increased and inversely correlated with BMD in acute SCI but decreased in chronic SCI, despite 50% bone loss. As a therapeutic target, anti-sclerostin antibody prevented or reversed bone loss in four preclinical SCI studies, as evidenced by increases in trabecular volume of up to 67%. These results were protected when the *SOST* (Sclerostin) gene was knocked out. Clinically, romosozumab, a humanised anti-sclerostin antibody, increased BMD and strength at the hip but not at the knee in chronic SCI populations. In contrast, mechanical interventions in preclinical and clinical models did not improve BMD or reduce sclerostin.

Conclusions: Sclerostin is a central mediator of SCI-induced bone loss with robust preclinical evidence but inconsistent clinical evidence. Romosozumab may be a potential pharmacological treatment for SCI-induced bone loss in chronic SCI, with no trial in acute SCI. Biomarker utility may be constrained by assay variability and temporal inconsistency. Standardised protocols for biomarker measurement and romosozumab trials in acute SCI are warranted.

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A biokinetic model of cobalt dispersion in patients with metal-on-metal Total Hip Replacement

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Abstract

Research Question: Can a biokinetic model be developed describing the dispersion of cobalt wear particles into the hip and then throughout the body of total hip replacement patients?

Methods: The model was based on the ICRP cobalt biokinetic model, describing the course across time of ingested or inhaled cobalt in blood, urine and four major systemic tissues: liver, kidney, bone and perfused tissues. This model was extended by compartments representing the hip (synovial fluid and membrane) and applying a typical time pattern of cobalt wear particle production by MoM prostheses. Cobalt concentrations across time for all compartments were calculated.

Results: Our model predicted a quickly rising cobalt concentration in synovial fluid, remaining high (Fig. 1A). In the synovial membrane, blood and urine it would rise steadily up to 6 months after implantation, slowly falling from then (Fig. 1B-C). Cobalt concentrations in liver and kidney would rise more slowly, reaching a peak at 2 years and slowly decrease hence onwards (Fig. 1D).

Conclusion: Predicted levels and patterns in time of blood and urine cobalt concentration correspond to values from longitudinal studies. The high levels in joint fluid also correspond to those measured in humans. The patterns of synovial membrane and blood levels matched closely, which will help interpreting measured blood levels. This biokinetic model can describe cobalt dispersion in the body following hip replacement and will assist the clinical interpretation of measured cobalt levels.

Declaration of Interest

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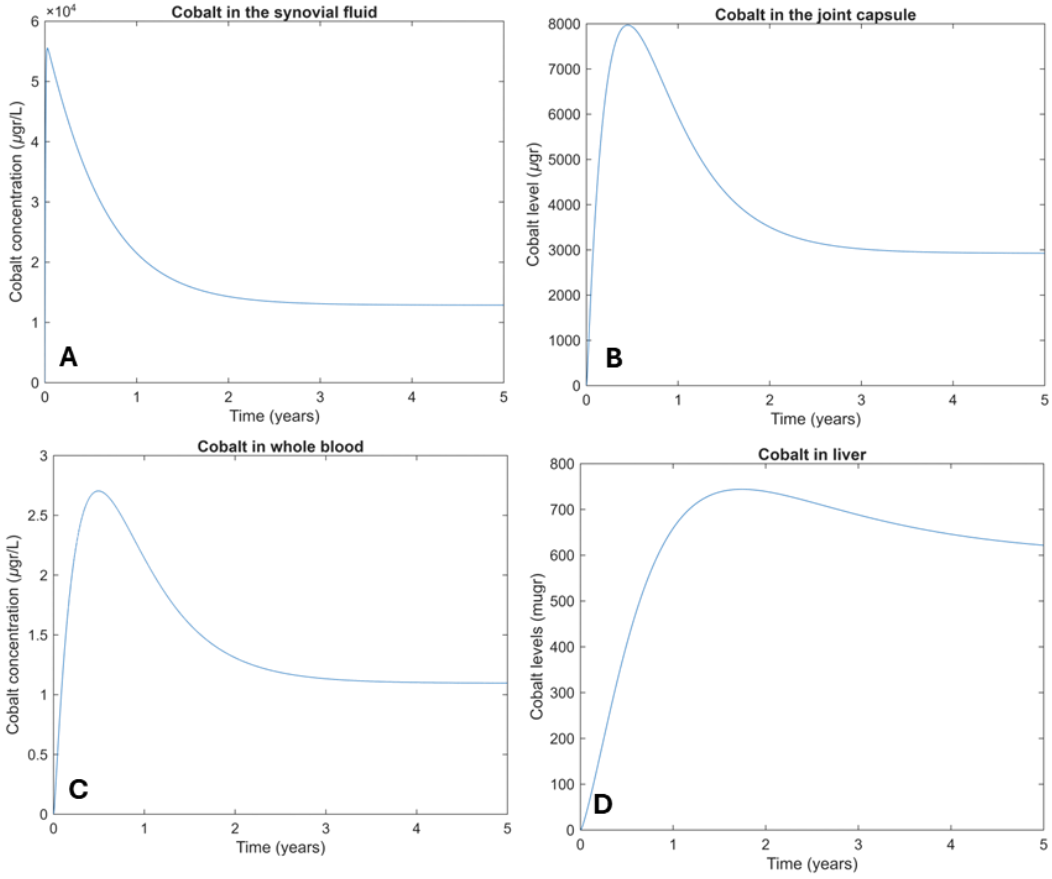
Cobalt in the synovial fluid
×10^4
Cobalt concentration (μgr/L)
Time (years)
A
Cobalt in the joint capsule
Cobalt level (μgr)
Time (years)
B
Cobalt in whole blood
Cobalt concentration (μgr/L)
Time (years)
C
Cobalt in liver
Cobalt levels (mugr)
Time (years)
D

Artificial intelligence is an effective adjunct for radiographic identification of bone tumours within the femur

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[1]NHS GGC, Glasgow, United Kingdom. [2]University of Glasgow, Glasgow, United Kingdom

Abstract

Deep Learning Artificial Intelligence models can be trained to analyse medical imaging as a decision support tool, postulated to improve speed and accuracy of X-ray analysis. Recent studies have demonstrated that integrating AI technologies within radiology may emulate or even surpass human cognitive ability to synthesise large volumes of data. Within orthopaedic oncology, the timely identification of potential neoplastic abnormalities is crucial; delays may lead to sub-optimal care, progression of pathology, and increased risk of distant metastasis. This problem may be compounded by the initial interpretation performed by non-specialised staff. We sought to create an AI model to identify presentation of both primary and secondary neoplasms within long bones, using retrospective analysis of radiographs for patients treated or discussed at a busy tertiary orthopaedic oncology centre. This focused on skeletal neoplasms of the proximal and distal femur. Following database interrogation, 148 patients were identified for this study, generating 401 radiographs showing both benign and malignant pathologies. These images were anonymised and uploaded to an encrypted image-labelling tool. Labelling was performed using distinct anatomical sites (e.g. epiphysis, metaphysis, diaphysis) and radiographic margins of the tumour. A control group of 96 images of normal femurs were also uploaded and labelled. We trained one 2D semantic segmentation model to identify bony anatomical structures and another to identify tumours. Both were implemented in nnUNet-v2, with custom focal & dice losses to improve recall. Evaluation used an 8-fold cross-validation, measuring diagnostic accuracy by correctly localised recall of pathologies. This model shows initial promising results, with 72% diagnostic accuracy. Image-level mean precision, specificity and recall were 0.968, 0.948 and 0.750, respectively. Our detection rate has shown consistent improvement with increasing training data volume, and further analysis using an expanded dataset is recommended before incorporating this model into the analysis of other long bones.

Declaration of Interest

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A Phenotyping study of the effects of nanovibrational stimulation on the differentiation of mesenchymal stem cells towards an osteoblastic lineage.

Michael McCormick[1,2], Monica Tsimbouri[1], Matthew Dalby[1], David Shields[1,3]

[1]University of Glagow, GLASGOW, United Kingdom. [2]NHS Lanarkshire Medical education, Wishaw, United Kingdom. [3]NHS Greater Glasgow and Clyde, GLASGOW, United Kingdom

Abstract

Research Question: Can Nanovibrational stimulation of MSCs drive an osteoblastic phenotype?

Introduction: Mesenchymal stem cells (MSCs) are multipotent cells able to differentiate into multiple lineages. Nanovibrational stimulation has been observed to mimic local mechanical signals allowing the MSC to undertake cellular changes which can influence them toward osteoblastogenesis. These changes can be monitored through the phenotypic expression of transcription factors, protein markers and surface markers. Protein expression markers used in this study were RUNX2, Osteopontin (OPN), Osteonectin (OSN) and osteocalcin (OCN) and MSC related surface markers CD271, CD166, CD29, CD105 and CD44.

Methods: Adipose derived MSCs were cultured in three conditions (nanovibrated, control media and osteogenic media) for a period of 28 days. After 28 days in culture, cells were either harvested and stained for surface markers using flow cytometry or were fixed for in cell western analysis. Cells were assessed for the expression of RUNX2, OPN, OSN, OCN and MSC surface markers CD271, CD166, CD29, CD105 and CD44. Results/ In cell western analysis revealed an increase in protein expression of mid and late stage osteogenesis (OCN, OSN and OPN) with OCN showing a median fold change of 1.5 to control (p=0.0004). RUNX2, an early stage marker for osteogenesis showed no difference in expression in the Nanovibrated or osteogenic media groups demonstrating that these groups have passed the stage of its crucial role in initiating osteogenesis. MSC surface marker analysis demonstrated a down trend of MSC surface markers at 28 days compared to 14 days in culture but nor statistically significant in any marker tested.

Conclusion: Nanovibrational stimulation can promote osteoblastic phenotypic protein expression in vitro while maintaining an MSC surface marker phenotype.

Declaration of Interest

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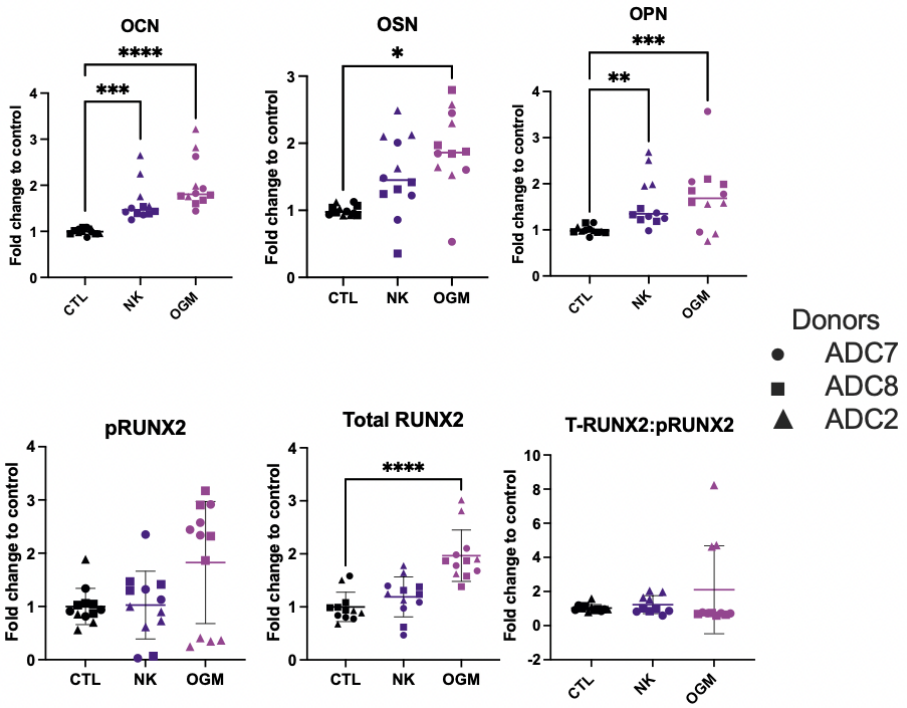
OCN
****
***
Fold change to control
CTL
NK
OGM
OSN
*
OPN
***
**
Donors
ADC7
ADC8
ADC2
pRUNX2
Total RUNX2
****
T-RUNX2:pRUNX2

51

Does nanovibrational stimulation of mesenchymal stem cells alter their capacity to modulate the activity of T-cells? An In vitro study.

Michael McCormick[1,2], Monica Tsimbouri[1], Matthew Dalby[1], David Shields[1,3]

[1]University of Glasgow, GLASGOW, United Kingdom. [2]NHS Lanarkshire Medical Education, Wishaw, United Kingdom. [3]NHS Greater Glasgow & Clyde, GLASGOW, United Kingdom

Abstract

Research Question: Does nanovibrational stimulation of mesenchymal stem cells alter their capacity to modulate the activity of T-cells? Introduction/ MSCs are known to have an immune suppressive function. If nano vibrationally stimulated cells (NK cells) are to be used in clinical trials and potentially as treatment alternatives to large volume bone grafts, it is important to know if these immune functions are altered during the differentiation process.

Methods: Adipose derived MSCs from 3 donors were cultured in two conditions (NK/control media) for a period of 28 days. T cells were isolated from 3 different donors and stained with Carboxyfluorescein succinimidyl ester (CFSE) each group was then split in half with half of the T cells being activated with PHA and IL-2. Each T cell condition was co-cultured with each MSC donor including a monoculture of each T cells donor as a control for 5 days when the samples were harvested. Half of the harvested T cells were then stained for Regulatory T cell surface markers and the other half processed for CFSE depletion using Flow cytometry.

Results: In all three T cell donors the co-culture conditions demonstrated similar generational data from proliferation statistics with similar proliferation indexes between the NK and MSC groups demonstrating that there was no significant difference in the interaction of MSCs and NK cells with T cells. There was a reduced expression of regulatory tcells seen in the percentage of cells expressing CD4+, CD8- and CD25+ however the monoculture controls had extremely low cell survival and so absolute cell numbers prevent drawing a conclusion without further data. Reassuringly there was no statistically significant difference in the differences between MSCs and NK in CD25+ expression or proliferation of T cells indicating no change in immune modulatory capacity of MSC after nanovibrational stimulation.

Declaration of Interest

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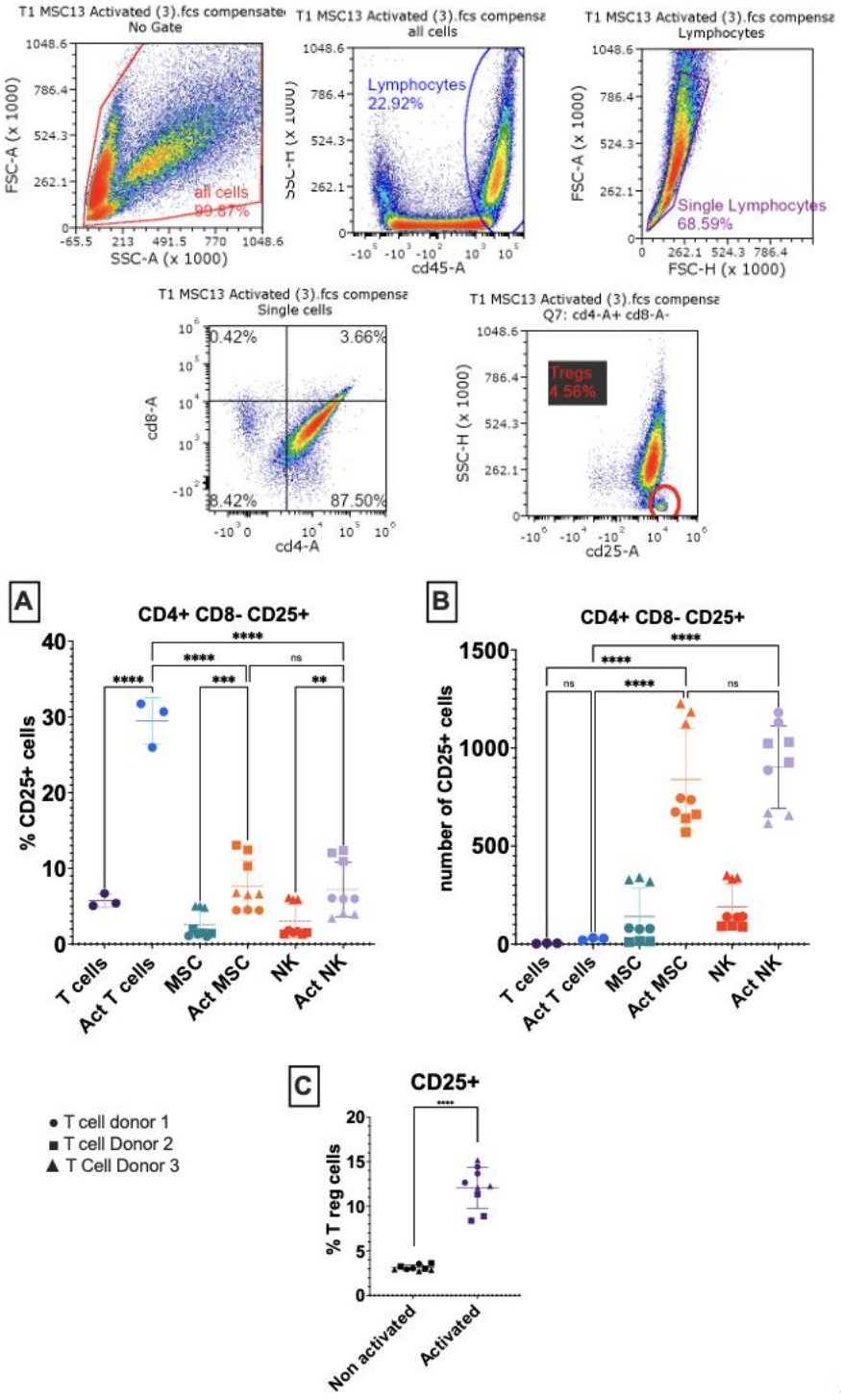
T1 MSC13 Activated (3).fcs compensate
No Gate
FSC-A (x 1000)
SSC-A (x 1000)
all cells
99.87%
T1 MSC13 Activated (3).fcs compensa
all cells
Lymphocytes
22.92%
cd45-A
T1 MSC13 Activated (3).fcs compensa
Lymphocytes
Single Lymphocytes
68.59%
FSC-H (x 1000)
T1 MSC13 Activated (3).fcs compensa
Single cells
0.42%
3.66%
8.42%
87.50%
cd8-A
cd4-A
T1 MSC13 Activated (3).fcs compensa
Q7: cd4-A+ cd8-A-
Tregs
4.56%
SSC-H (x 1000)
cd25-A
A
CD4+ CD8- CD25+
% CD25+ cells
T cells
Act T cells
MSC
Act MSC
NK
Act NK
B
CD4+ CD8- CD25+
number of CD25+ cells
C
CD25+
% T reg cells
Non activated
Activated
T cell donor 1
T cell Donor 2
T Cell Donor 3

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Automated Hallux Valgus Angle Measurement Across Deformity Severity Using Oriented Bounding Box Detection

Alistair Lawley[1], Andrew Brunt[1,2], Rory Hampson[1], Kalpesh Shah[2], Gordon Dobie[1]

[1]University of Strathclyde, Glasgow, United Kingdom. [2]NHS Goldern Jubilee Hospital Trust, Glasgow, United Kingdom

Abstract

Research Question: Manual measurement of the hallux valgus angle (HVA) and intermetatarsal angle (IMA) from weightbearing anteroposterior foot radiographs is central to surgical planning but is time-consuming and subject to inter-observer variability. Existing automated approaches show promise but frequently degrade in accuracy with increasing deformity severity, precisely the cases where measurement reliability matters most. We asked whether a deep learning model could automate HVA measurement with clinically acceptable accuracy across the full spectrum of hallux valgus severity, including severe deformity.

Methods: A YOLO11-based oriented bounding box (OBB) detection model was trained on the HVAngleEst dataset to localise the proximal phalanx and first and second metatarsal shaft axes directly from radiograph images. Patient-stratified train/val/test splits (70/15/15) were constructed with severity-balanced stratification across mild (<20°), moderate (20–40°) and severe (>40°) deformity, ensuring zero patient leakage between splits. HVA was derived geometrically from predicted shaft orientations. Hardy-Clapham (HC) sesamoid position was graded geometrically using segmentation masks from the same pipeline. Performance was evaluated on a held-out test set against radiograph-derived ground truth.

Results: On the test set (n=232 feet), HVA mean absolute error (MAE) was 1.71° (median 1.36°), with 64.7% of predictions within 2° and 96.6% within 5° of ground truth. Accuracy was uniform across severity strata: MAE was 1.70° (mild, n=15), 1.73° (moderate, n=150) and 1.66° (severe, n=67). HC sesamoid grading achieved 80.1% within one grade of ground truth (n=221).

Conclusions: An OBB-based deep learning model achieves clinically relevant HVA accuracy across the full deformity spectrum, comparing favourably with published state-of-the-art performance. The absence of severity-related degradation addresses a key limitation of prior automated approaches and supports reliable deployment across the case mix presenting to hallux valgus surgical services. Ongoing work targets IMA validation and independent surgeon ground truth comparison to support clinical translation.

Declaration of Interest

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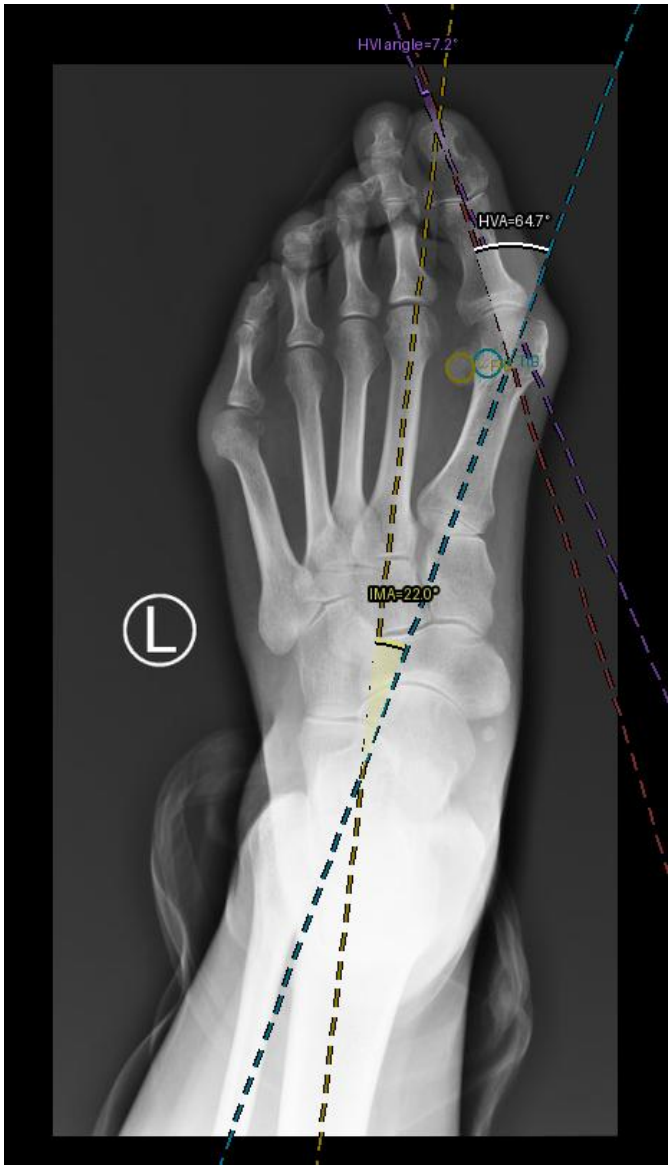
HVI angle=7.2°
HVA=64.7°
IMA=22.0°
L

55

Molecular Profiling of Bone Regeneration in an Ovine Femoral Condyle Defect Model: RT-qPCR versus Proteomics

Sasza Chyntara Nabilla[1], Luyang Xu[1], Bruno M. Gil Rosa[1], Gordon Blunn[2], Frederic Cegla[1], Thomas A.G. Hall[1], Richard J. van Arkel[1]

[1]Imperial College London, London, United Kingdom. [2]University of Portsmouth, Portsmouth, United Kingdom

Abstract

RESEARCH QUESTION: Extracting intact RNA and proteins from mineralized bone is challenging. This study aimed to optimize RT-qPCR and LC-MS proteomics workflows and assess their suitability for studying bone regeneration mechanisms.

METHODS: This study was performed under Home Office License No. P16F4AA0A. In four ewes (N=4), 3D-printed cp-Ti implants (⌀8 × 16 mm) were placed in femoral condyle defects. Bone samples were collected on day 0 and 42 using sterile, RNA-free tools and were stored in RNAlater at -80°C. RT-qPCR evaluated 42 RNA extraction protocols (n=3), measuring VEGF, BGLAP, and TNFSF11 normalized to TBP. Proteomics used EasyPep Mini MS Sample Prep Kit extraction and LC–MS (3 replicates), with DIA-NN identification (UniProt Ovis aries) and downstream analysis in MATLAB and R (limma) (Fig. 1).

RESULTS: RNA yields ranged from 0.4 ± 0.1 to 53.9 ± 1.9 ng/µl. Highest yield obtained from PureLink + Trizol-chloroform + isopropanol, but with poor purity (1.39 ± 0.01). In contrast, 0.2 ml dual- and 0.5 ml single- chloroform methods produced higher purity RNA (1.87 ± 0.33 and (1.75 ± 0.03) but lower yields (6.4 ± 3.5 and 17.1 ± 1.1 ng/µl). High-purity RNA (1.87) generated consistent CT values (31.9 ± 1.4, 28.2 ± 2.1, 29.7 ± 1.6) across VEGF, BGLAP, and TNFSF11. Slightly lower purity RNA (1.75), despite higher concentration, showed higher CT values (34.1 ± 0.5, 31.3 ± 0.1, 34.1 ± 0.9) and 50% undetermined samples, indicating reduced reliability. Protein extraction was faster and more stable. Protein concentration ranged from 50 to 380 ng/µl. LC-MS identified 6,745 proteins, with 546 upregulated and 348 downregulated.

CONCLUSION: RNA extraction from bone is constrained by a yield-purity trade-off affecting RT-qPCR reliability. Proteomics provides robust, high throughput data with greater molecular coverage, supporting its suitability for bone regeneration studies. ACKNOWLEDGEMENTS: UKRI (EP/Z533415/1), Wellcome Trust (223797/Z/21/Z), Imperial (DT-Prime, FILM).

Declaration of Interest

(a) fully declare any financial or other potential conflict of interest

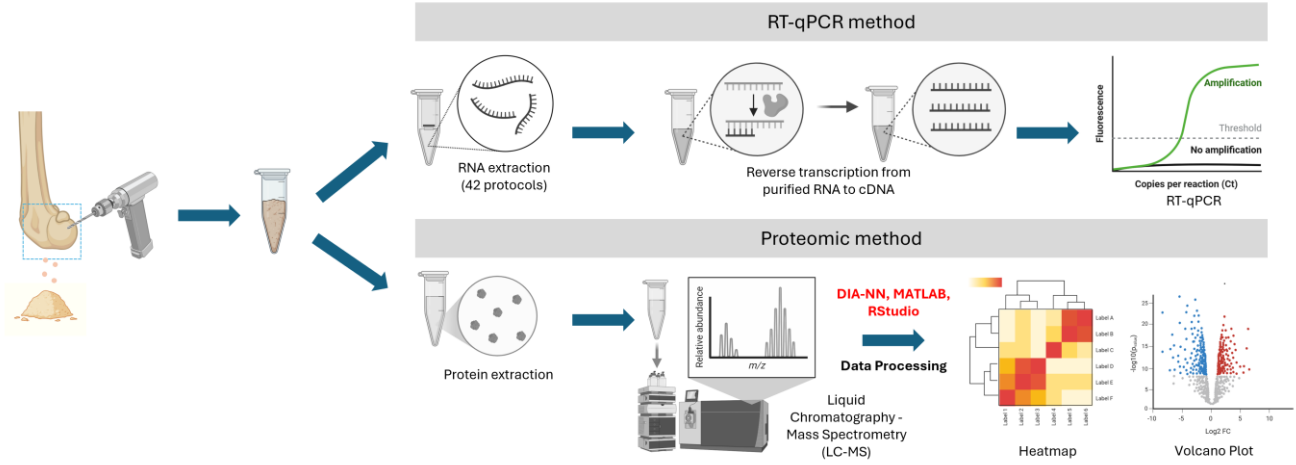

Figure 1. Comparison of RNA and protein extraction workflows, with proteomic results showing upregulated and downregulated proteins.

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Development of a Conditional, Cell-specific, AAV Construct for Osteoarthritic Cartilage Gene Therapy

Livia-Mae Hallett, Ilyas Khan

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Abstract

Research Question: Sustained trauma can trigger progressive degradation of articular cartilage, a specialised connective tissue that provides a smooth surface for joint articulation, leading to the development of osteoarthritis (OA), causing severe joint pain and reduced mobility. Due to its avascularity and paucity of cells, cartilage has a limited regenerative capacity; consequently, there are no current treatments available that effectively target aberrant degradation. Research has shown that disease progression is driven in part by the chronic activation of matrix metalloproteinases that break down the major structural proteins collagen type II and aggrecan.

Methods: Due to the nano-porosity of the extracellular matrix of cartilage, adeno-associated virus (AAV) vectors pose as ideal vehicles to modify the expression of tissue inhibitors of metalloproteinases (TIMPs). To regulate TIMP expression and reduce adverse effects on surrounding tissues, we designed AAV vectors to be conditionally activated by a TetOn-3G tetracycline-inducible transactivator that is driven by the cartilage-specific enhancer/promoter 4eCOL2A1. Test constructs were initially made with the tetracycline transactivator (tTA) Tet-Off system, active in the absence of doxycycline, using green fluorescent protein (GFP) and Luciferase as reporters.

Results: We found 4eCOL2A1 activity was conditional upon the presence of cartilage-specific transcription factor SOX9, confirming tissue specificity, where the addition of doxycycline suppressed tTA activity. Constructs were then made with the TetOn-3G gene and activated in chondroprogenitors upon exposure to doxycycline, confirmed using GFP fluorescence and Luciferase assays. Building upon these results, TIMP1/2 isoforms have been cloned into our constructs to explore the therapeutic potential of monocistronic constructs compared to combinatorial expression cassettes using bovine articular cartilage explant ex vivo studies.

Conclusions: We have designed and validated a conditional, cell-specific, AAV construct using advanced gene therapy techniques to target underlying cartilage degradation in OA. Our construct could improve upon currently available treatments that inefficiently prevent OA disease progression.

Declaration of Interest

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A CT-only statistical shape model for femorotibial cartilage thickness prediction: impact on knee contact mechanics and implications for arthroplasty planning

Roberto Leonardo Diaz, Sophie Williams, Ruth Wilcox

University of Leeds, Leeds, United Kingdom

Abstract

RESEARCH QUESTION: Accurate cartilage thickness distribution is essential for realistic contact mechanics simulations [1]; however, obtaining bone and cartilage surfaces from the same imaging source is not always possible. Statistical shape models (SSMs) offer the potential to apply cartilage layers to bone models derived from radiographic imaging that does not capture the soft tissue, however SSMs often combine data from different imaging modalities. This study asks: can a CT-only statistical shape model (SSM) accurately predict femorotibial cartilage thickness and provide more reliable contact mechanics than conventional cross-modality approaches?

METHODS: A single-modality SSM was developed using tibiofemoral bone and cartilage masks segmented from high-resolution CT scans (n= 8, voxel size 82µm). Following alignment and resampling for node correspondence, Principal Component Analysis was applied to bone shape and cartilage thickness. Model accuracy was assessed via a held-out control. Contact mechanics were compared using FE models with the (original) segmented cartilage and with cartilage derived using the above SSM ('SSM-CT'), a 1 SD shift of this model ('SSM-CT-1SD'), and a SSM derived from MRI data ('SSM-MRI').

RESULTS: The SSM-CT successfully reproduced spatial thickness distributions but overestimated total volume by 20%; the –1 SD variant reduced this error to 11%. Compared to ground truth, SSM-CT yielded lower peak stress (–11.9%) and contact area (–15.3%), whereas SSM-CT+1SD matched peak stress within 1.2%. Crucially, the MRI-derived SSM produced higher errors across all mechanical metrics, highlighting the impact of cross-modality inconsistency.

CONCLUSIONS: The SSM-CT model produced cartilage thickness with a systematic overestimation but maintained a similar distribution. Crucially, better results were achieved when both cartilage and bone models were derived from a single, consistent imaging modality like µCT. Despite the limited sample size to train the model, this method demonstrates strong potential for adding cartilage to image-derived bone models for contact biomechanics research.

Declaration of Interest

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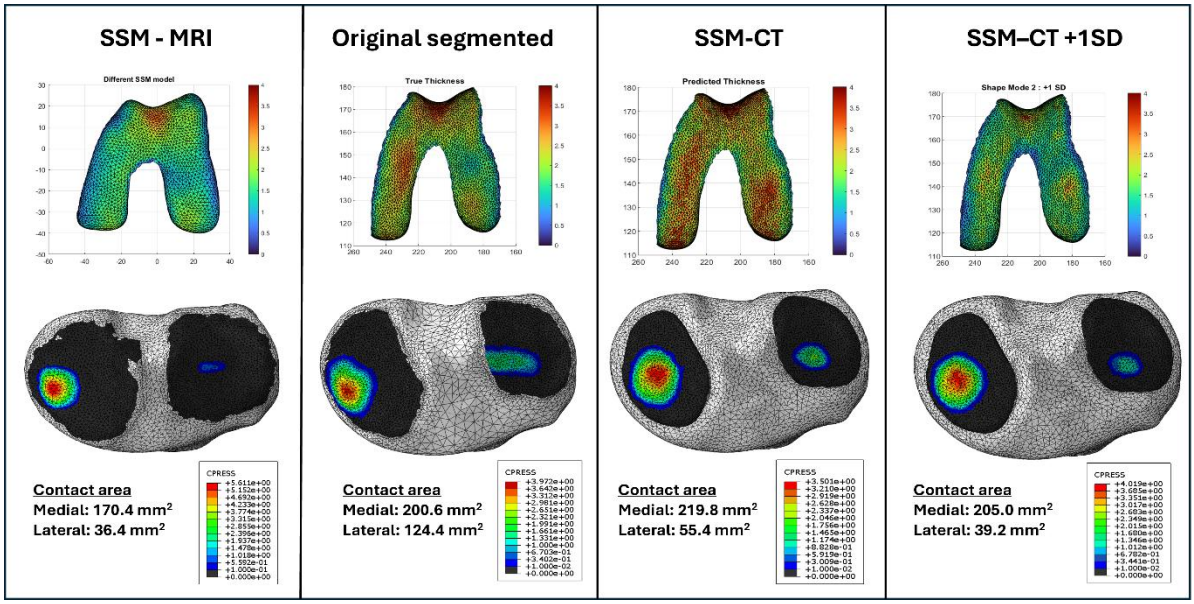

61

Towards contactless functional assessment in orthopaedic rehabilitation: radar-based 30s sit-to-stand monitoring

Alistair Keith[1,2], Jon Clarke[2,3], Oliver Hayman[1], Stuart Gray[1], Aleksandra Vuckovic[1], Alana Acheson[1], Julien Le Kernec[1,2]

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[3]University of Strathclyde, Glasgow, United Kingdom

Abstract

Research Question: The 30s sit-to-stand (STS) test is widely used in older adults and orthopaedic rehabilitation, including knee osteoarthritis and arthroplasty pathways, but clinical scoring is reduced to repetition count, discarding pacing and timing information. Motion capture provides detailed movement information but remains impractical for routine clinical use. Can contactless radar reproduce STS repetition count and estimate whole-trial mean repetition timing against motion capture, supporting low-burden temporal metrics within existing clinical workflows?

Methods: Twelve adults (age 70.3 ± 3.7 years) completed a 30s STS test with concurrent radar and motion-capture recording. Repetitions and whole-trial mean inter-repetition time were extracted from radar and compared against motion-capture-derived repetition count and mean repetition timing.

Results: Radar repetition counting showed strong agreement with motion capture: 8/12 trials matched exactly, while the remaining 4/12 differed by only ±1 repetition. Whole-trial mean inter-repetition timing closely matched between modalities, with a motion-capture mean of 1.761 ± 0.528s and radar mean of 1.756 ± 0.523s. Bland-Altman analysis showed a mean bias of -0.006 ± 0.021s, with mean absolute error of 0.013 s and root-mean-square error of 0.021s.

Conclusions: Radar reproduced the standard STS count and closely estimated whole-trial mean repetition timing, supporting its use as a low-burden adjunct to functional testing. By adding automated radar metrics to an existing assessment, this approach could improve recovery assessment in knee osteoarthritis and arthroplasty rehabilitation. Earlier identification of recovery, plateauing or decline could support rehabilitation adjustment, clinical review and clearer patient feedback. Longer term, radar could provide objective movement data earlier and more frequently without markers, wearables or workflow disruption. Validation is underway in a 24-patient knee arthroplasty study recording STS pre- and post-operatively with radar, motion capture and force plates to evaluate whether radar metrics track functional change.

Declaration of Interest

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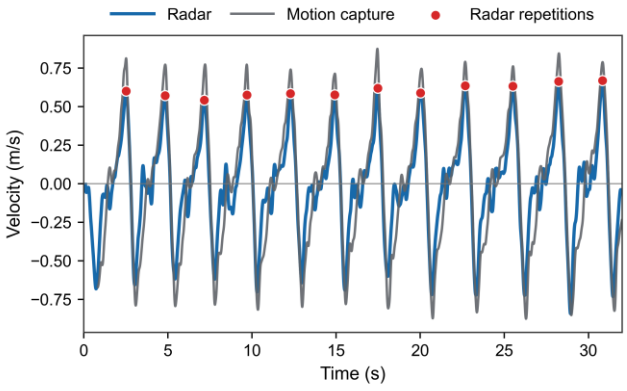
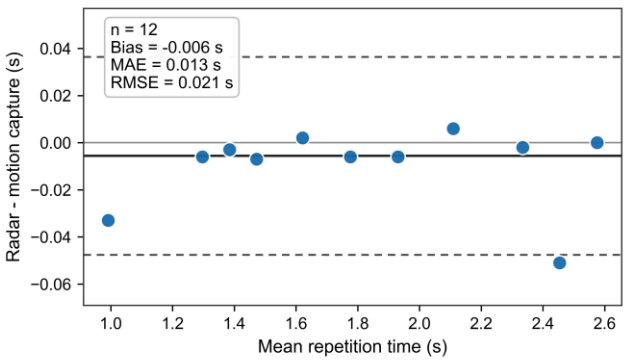


(a) Representative 30-s sit-to-stand trial



(b) Bland-Altman plot showing agreement between radar and motion capture for whole-trial mean repetition time

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Artificial Intelligence for Lower Limb Trauma Segmentation

Matthew Arnold[1,2], Ramitha Mahadevan[1], Paul Henderson[1], David Shields[1,2]

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Abstract

Research Question: Intraoperative fluoroscopic guidance is essential in orthopaedic trauma surgery for accurate implant positioning, however, image uncertainty can necessitate prolonged operative time, excessive radiation exposure and occasionally results in suboptimal bone or implant alignment. Artificial intelligence (AI) enhanced image analysis could provide surgeons with real-time information via 2D overlays or 3D reconstructions which could potentially improve surgical outcomes and reduce radiation burden. This study investigated whether a deep learning model can reliably recognise intact bones, fractures, and metalwork in lower limb radiographs.

Methods: A dataset of 320 radiographs depicting tibias and fibulas (categorised into intact, fractured, or containing metalwork) was annotated using LabelStudio and used to train a deep learning segmentation model (YOLO11). Model performance was evaluated on 120 previously unseen radiographs (40 per category) using the Dice Similarity Coefficient (DSC) as the primary evaluation metric. Pairwise comparisons were performed using Mann-Whitney U tests with Bonferroni correction applied for three comparisons.

Results: The model demonstrated strong segmentation accuracy across all three categories. Mean DSC values were: intact bone (0.953 ± 0.091, 95% CI [0.925, 0.981]), fracture (0.944 ± 0.043, 95% CI [0.931, 0.958]), and metalwork (0.934 ± 0.072, 95% CI [0.912, 0.956]). Median DSC values exceeded 0.96 in all categories, with lower means reflecting cases of missed bone detection on certain views. After Bonferroni-corrected pairwise comparisons, intact images scored significantly higher than both fracture ($p = 0.002$) and metalwork ($p < 0.001$), with no significant difference between fracture and metalwork.

Conclusion: Deep learning models show promise for automated bone and hardware segmentation in trauma radiographs, with strong performance across bony anatomy and metalwork . However, large variability between images reflect the heterogeneity of patient radiographs and suggest further model refinement and expanded training datasets are required before this technology can be utilised clinically.

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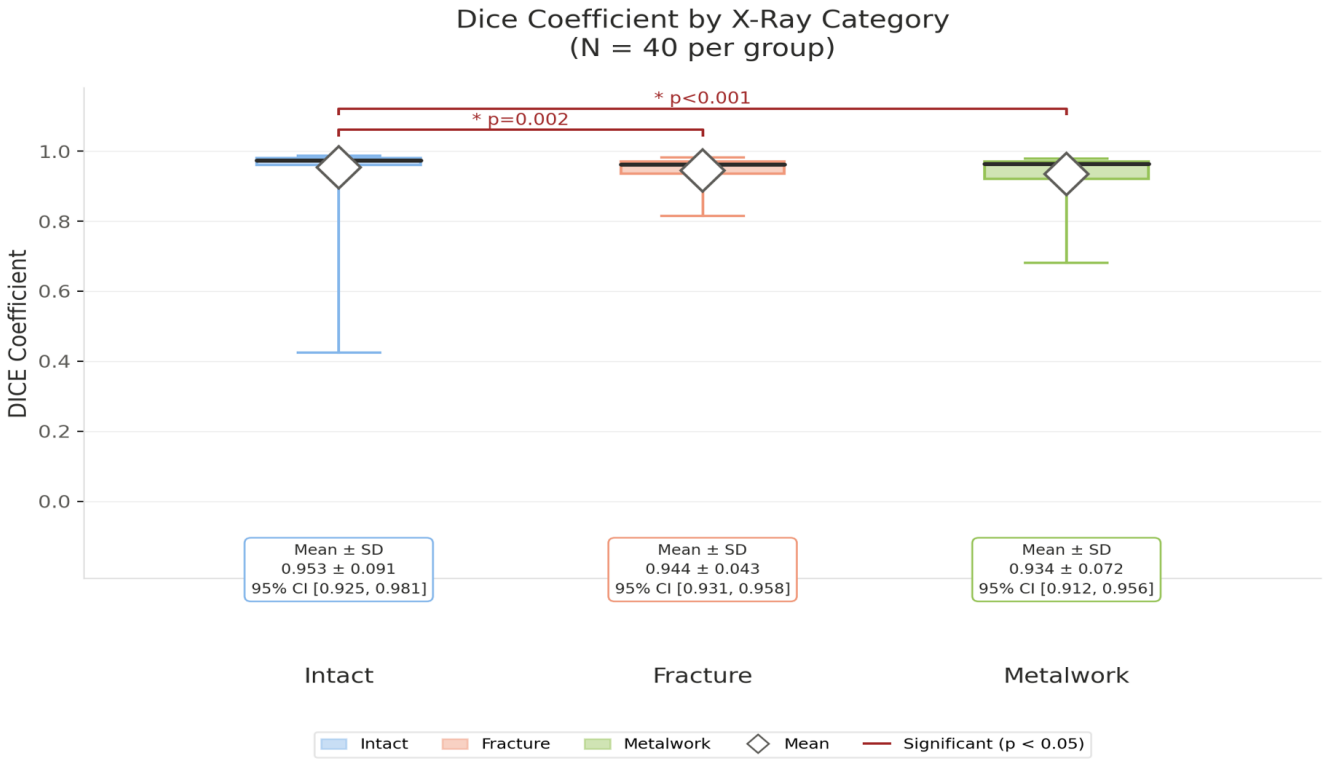
Dice Coefficient by X-Ray Category
(N = 40 per group)
* p<0.001
* p=0.002
DICE Coefficient
1.0
0.8
0.6
0.4
0.2
0.0
Mean ± SD
0.953 ± 0.091
95% CI [0.925, 0.981]
Mean ± SD
0.944 ± 0.043
95% CI [0.931, 0.958]
Mean ± SD
0.934 ± 0.072
95% CI [0.912, 0.956]
Intact
Fracture
Metalwork
Intact
Fracture
Metalwork
Mean
Significant (p < 0.05)

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Evaluating the outcomes of post-operative blood tests following joint arthroplasty.

Jann En Leong, Matthew Smith, Brodie Rowlands, Soorya Siva, Brian Rooney

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Abstract

Research Question: Post-operative laboratory tests are routinely obtained following joint arthroplasty. We evaluate the outcomes of post-operative blood tests.

Methods: A retrospective analysis across two high-volume arthroplasty centres over February to March 2025 was conducted. We included all adult patients with a primary unilateral joint replacement due to osteoarthritis. Electronic medical records were reviewed for demographics, length of stay, and blood tests. Blood tests included Full Blood Count (FBC), Urea and Electrolytes (U+Es), Liver Function Tests (LFTs) and C-Reactive Protein (CRP). Post-operative blood tests were evaluated to identify abnormalities and subsequent interventions.

Results: 147 patients were included, with a mean age of 70 years old and 92 (62.5%) were female. 63 (42.2%) had a total hip replacement (THR), 70 (47.6%) had a total knee replacement (TKR) and 15 (10.2%) had a unicompartmental knee replacement (UKR). 135 (91.8%) patients had post-operative blood tests. Mean post-operative haemoglobin for THR and TKR was 115 and 118 respectively. Post-operative blood transfusion was done for symptomatic anaemia, of which 4 THR and 1 TKR patient were transfused. For UKR, only 3 of 15 patients had post-operative blood tests, mean post-operative haemoglobin was 133. 6 (4.1%) had acute kidney injury, all requiring intervention. 7 (4.76%) had electrolyte abnormalities with 2 (1.4%) requiring intervention. 16 (10.9%) and 23 (15.6%) patients respectively had LFTs and CRP done, none were actionable.

Conclusion: Post-operative blood testing may not be required for all patients undergoing primary arthroplasty. In cases where post-operative blood tests are conducted, it should be limited to FBC and U+Es.

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The role of soft tissue structures in the rotational stability of the distal tibiofibular (syndesmosis) joint.

Keir John Robson, Enrico Dall'Ara, Claire Brockett

Insigneo Institute, University of Sheffield, Sheffield, United Kingdom

Abstract

Research Question: How do the tissue structures of the lower leg, ankle, and foot contribute to the passive rotational stability of the syndesmosis joint?

Methods: A sequential dissection study was undertaken to evaluate the contribution of soft tissues to the passive stability of the syndesmosis at the ankle. A full intact lower limb (tibial plateau) was mounted in an electromechanical testing machine (BOSE Electroforce 3510). Mechanical testing was undertaken under three loading conditions: 750 N axial load at 10 N/s; 20° external rotation at 0.5 Nm/s; and a combined loading scenario using the same parameters. The motion of the joint was evaluated using a (Qualysis) motion capture system by calculating the relative displacement of the fibula with respect to the tibia in all planes at each dissection stage and compared to the intact limb. The dissection stages consisted of proximal tibiofibular removal, forefoot ligament sectioning, soft tissue removal, lateral ligament sectioning, and deltoid ligament sectioning.

Results: Increased posterior displacement (1 - 2 mm) of the fibula relative to the tibia was observed following removal of the proximal tibiofibular joint. After soft tissue removal, lateral displacement increased (range: 1.6 - 1.9 mm), posterior displacement increased (range: 1.6 - 2.9 mm), and inferior displacement increased (range: 1.2 - 2.2 mm).

Conclusions: A reproducible experimental methodology was successfully developed to study the effect of sequential sectioning stages on the rotational stability of the syndesmosis. This was a preliminary study with n = 1; therefore, conclusions are limited at this stage, and additional specimens are required to generalise the findings. For this specimen, the proximal tibiofibular joint acted to constrain the fibula, particularly in the posterior plane. The soft tissues acted to constrain the movement of the fibula in all planes.

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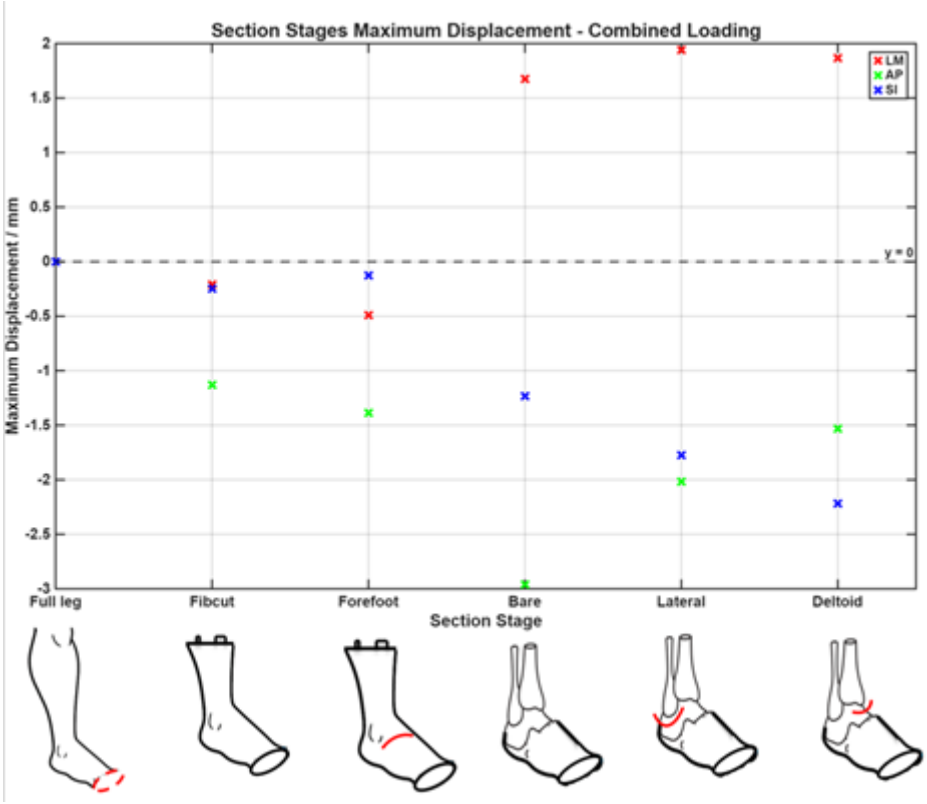
Section Stages Maximum Displacement - Combined Loading
Maximum Displacement / mm
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
y = 0
LM
AP
SI
Full leg
Fibcut
Forefoot
Bare
Lateral
Deltoid
Section Stage

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Effect of full ankle plantar flexion on the gap of acute tendo-achilles ruptures, an ultrasound-based study

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Abstract

Research Question: Acute Achilles tendon ruptures (ATRs) are common injuries. The degree of initial tendon diastasis frequently guides conservative or surgical treatment using ultrasonographic assessment in ankle dorsiflexion (neutral) and plantar flexion. While plantar flexion is widely considered to reduce tendon separation, the extent of this and the influence of the gap in neutral ankle position remains unclear. This study aims to evaluate initial tendon diastasis and the gap reduction in full plantar flexion.

Methods: This study included 73 patients aged ≥18 years presenting with ATR between April 2021 and January 2026. All cases were confirmed by ultrasonography within 21 days of injury. Tendon gap measurements were obtained in both neutral and maximal plantar flexion, along with distance from the calcaneal insertion. Variables, including age, sex, laterality, and time to scan were recorded. Absolute and relative reductions in tendon gap were calculated.

Results: The mean tendon gap decreased from 13 mm (range, 0 to 51) in neutral to 9.59 mm (range, 0 to 37) in maximal plantar flexion. Mean absolute and relative reductions were 3.7mm and 30.8%, respectively, with 24.6% of cases achieving full apposition. No association was observed between baseline gap size and subsequent relative reduction. However, stratified analysis (<10mm, 10 mm to <15 mm, 15 mm to <20 mm, ≥20 mm) demonstrated significantly greater relative reduction in the <10 mm group compared to the 10 mm to <15 mm (p=0.0037) and ≥20 mm groups (p=0.0496). Age, sex, distance from the calcaneal insertion, laterality, and time to ultrasound were not significantly associated with relative reduction

. Conclusion: Ankle equinus significantly reduces tendon gap distance, confirming the limited existing literature. Smaller initial gaps (<10 mm) are associated with greater relative reduction, suggesting baseline diastasis may predict tendon apposition. Future research could help evaluate the significance of this in clinical practice.

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Validation of micro finite element models of the growth plate under physiological loading

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Abstract

Research Question: Bone growth is regulated by factors, including those arising from mechanical loading, with alterations in the mechanical environment associated to musculoskeletal deformities (Carter & Wong, 2003). Computational models allow to investigate how changes in mechanical stimuli influence growth, however, current models fail to account for the complex microarchitecture and properties of the chondro-osseus junction at the growth plate (Gao et al 2015, Yadav et al 2016). Here, we develop and validate a micro finite element (µFE) model of the bone-growth plate unit to investigate the influence of bone microarchitecture and cartilage heterogeneity in its mechanical response.

Methods: We performed in situ µCT compression testing in ovine bone-growth plate units. We generate µFE models based on segmented images (Peña Fernández et al 2022). Three µFE models were compared: (i) homogeneous bone and cartilage, (ii) heterogenous bone and homogeneous cartilage, and (iii) heterogeneous bone and cartilage. Bone was modelled as linear elastic (E=100MPa, ν=0.3) and cartilage as either elastic (E=1MPa, ν=0.45)(Gao et al 2015) or transversely isotropic poroelastic following Sergerie et al (2009). Boundary conditions replicated experimantal testing.

Results: Homogeneous models resulted in high strain concentration in the growth plate cartilage and overestimation of stiffness, whereas accounting for bone microarchitecture led to better experimental agreement. Transversely isotropic properties for cartilage reducted excessive transverse deformations observed in linear models, while cartile heterogeneity improved model predictions, with proliferative and hypertrophic zones showing larger deformations than reserve zone.

Conclusion: Our results highlight the importance of bone microarchitecture and heterogeneous non-elastic cartilage properties for growth plate strain predictions, which are typically neglected in bone growth simulations (Gao et al 2015, Yadav et al 2016). These µFE models can be exploited to provide new insight into the mechanical factors that regulate growth plate ossification, enabling predictions of local mechanical environmental under different loading conditions.

Declaration of Interest

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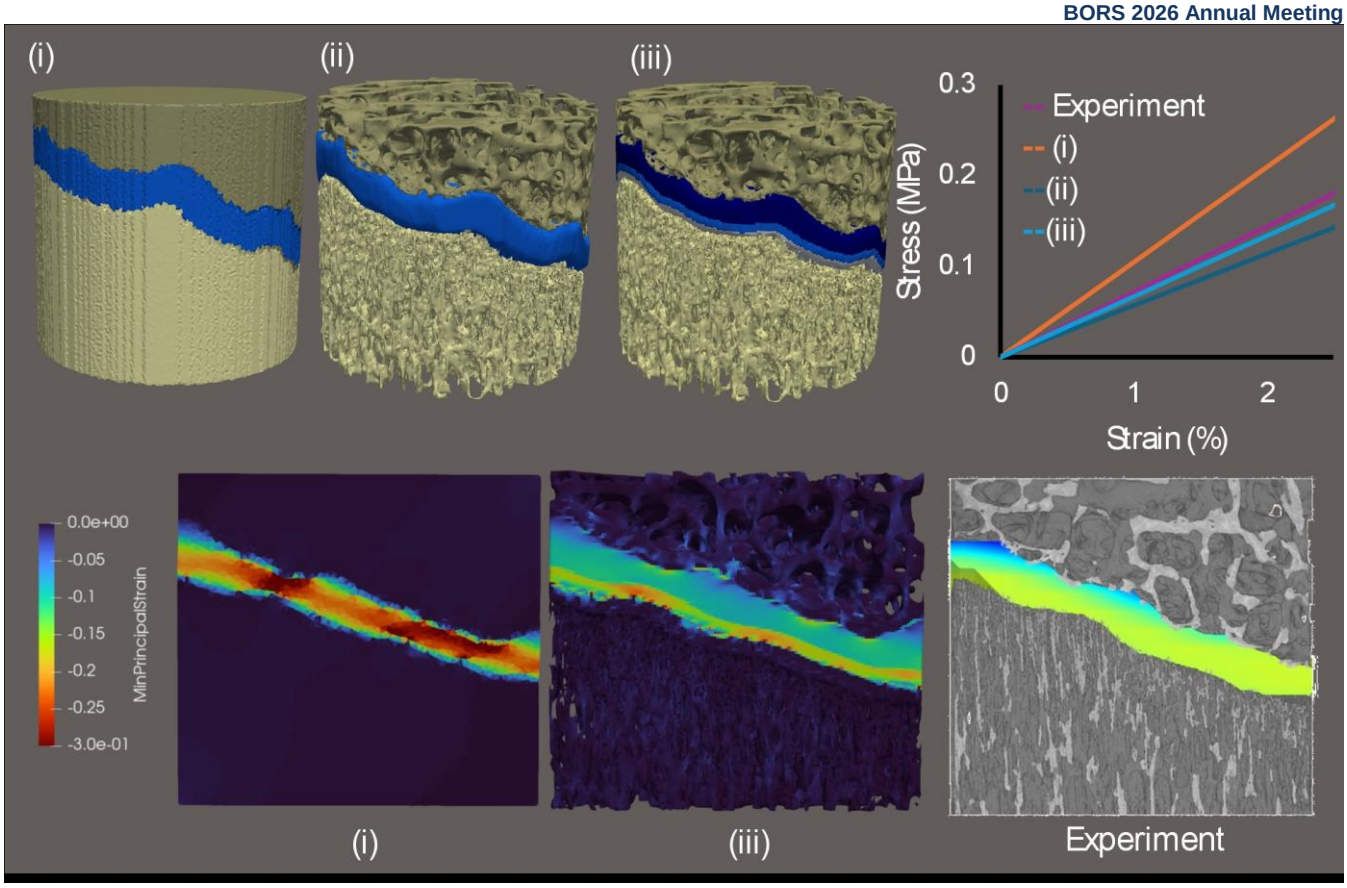
(i)
(ii)
(iii)
0.3
0.2
0.1
0
Stress (MPa)
Experiment
(i)
(ii)
(iii)
0
1
2
Strain (%)
0.0e+00
-0.05
-0.1
-0.15
-0.2
-0.25
-3.0e-01
MinPrincipalStrain
(i)
(iii)
Experiment

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Accelerometer-Derived Physical Activity 17 Years Following Hip Resurfacing and Total Hip Arthroplasty: Long-Term Follow-up of a Randomised Trial

Milos Brkljac[1], Sree Kanakala[1], Lex D. de Jong[2], Job L.C. van Susante[2], Tim Lindsay[1], Justin Cobb[1]

[1]Imperial College London, London, United Kingdom. [2]Department of Orthopaedics, Rijnstate Hospital, Arnhem, Netherlands

Abstract

Research Question: Hip resurfacing arthroplasty (HRA) has been proposed to facilitate higher levels of physical activity than total hip arthroplasty (THA). Our previously published randomised trial demonstrated that HRA more closely restored physiological gait patterns at higher walking speeds. Whether these biomechanical differences translate into greater real-world physical activity at long-term follow-up remains unclear. We therefore compared objectively measured physical activity between HRA and THA approximately 17 years following surgery.

Methods: Participants from the original randomised trial underwent long-term follow-up using a wrist-worn triaxial accelerometer (GENEActiv) worn continuously for 10 days. Raw accelerometer data were processed to derive Euclidean Norm Minus One (ENMO), from which sedentary time (ST), light physical activity (LPA), moderate-to-vigorous physical activity (MVPA), and physical activity energy expenditure (PAEE) were calculated. Patient-reported outcome measures included the Oxford Hip Score (OHS), EQ-5D-5L, and UCLA Activity Rating Scale.

Results: Thirty-two participants provided valid accelerometer data (HRA n=18; THA n=14) at mean follow-up of 16.9±0.7 and 17.0±0.9 years, respectively. OHS and EQ-5D scores were excellent and comparable between groups (OHS: 44.8±4.7 vs 45.7±3.5, p=0.56; EQ-5D: 0.91±0.09 vs 0.89±0.11, p=0.62). Most participants reported high postoperative activity levels (UCLA ≥7: 67% HRA vs 71% THA). PAEE, ST, and LPA were similar between groups. Median MVPA was higher following HRA (27.0 [14.4–36.8] vs 20.6 [9.5–32.6] min/day), although this did not reach statistical significance (p=0.26).

Conclusions: At 17 years following surgery, patients undergoing both HRA and THA demonstrated excellent patient-reported outcomes and comparable objectively measured physical activity levels. Despite the limited sample size, this study demonstrates the feasibility of validated accelerometry protocols to objectively quantify long-term activity following hip arthroplasty and provides a foundation for larger future studies investigating implant-specific functional outcomes.

Declaration of Interest

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French paradox stems require greater torque-to-fracture than polished taper-slip designs in composite femurs: a biomechanical study

Milos Brkljac[1], Jonathan Holt[1], Diego J. Restrepo[2], Alex Hooke[3], Nathan Flath[3], Richard Van Arkel[4], Ichiro Tsukamoto[2], Rafael J. Sierra[2], Justin Cobb[1], Kartik Logishetty[5]

[1]Imperial College London, London, United Kingdom. [2]Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN, USA. [3]Biomechanics Laboratory, Division of Orthopedic Research, Rochester, MN, USA. [4]Department of Mechanical Engineering, London, United Kingdom. [5]University College London, London, United Kingdom

Abstract

Research Question: Periprosthetic femoral fractures (PFFs) are now the leading cause of reoperation following total hip arthroplasty (THA), with morbidity and mortality comparable to hip fracture. Cemented polished taper-slip (PTS) stems are associated with increased fracture risk and more complex patterns. Alternative cementation strategies, including the “French paradox” thin-mantle technique, may mitigate this risk. We compared torque-to-fracture and fracture pattern between two French paradox stems differing in geometry and collar presence, and a PTS stem, using an established composite femur model, to determine whether biomechanical behaviour remained consistent within the same cementation philosophy.

Methods: Eighteen composite femurs were implanted with three cemented stems (n=6 per group): a PTS and two French paradox designs (AMIS-C and AMIS-K). Specimens were tested to failure using a torsional loading protocol. Peak torque-to-fracture was recorded, and fracture patterns classified using the Universal Classification System (UCS). Statistical analysis was performed using ANOVA and Kruskal–Wallis testing, with post hoc Dunn testing and Holm adjustment for pairwise comparisons.

Results: Mean torque-to-fracture was significantly lower in the PTS group (191.5 ± 25.8 Nm) compared with AMIS-C (241.8 ± 35.6 Nm) and AMIS-K (242.5 ± 43.9 Nm) ($p = 0.041$). Fractures in the PTS group were exclusively UCS type B (N = 6), with 67% (N=4) classified as B2. In contrast, fractures in the AMIS-C and AMIS-K groups were predominantly distal (type C: N=4 and N=3, respectively).

Conclusions: Both French paradox stems, despite differences in geometry and collar presence, demonstrated greater resistance to torsional failure and produced fracture patterns potentially more amenable to fixation than the PTS stem. These findings suggest that the biomechanical advantages of thin-mantle cementation may be maintained across differing stem designs and reduce both the risk and severity of periprosthetic femoral fracture. Adoption of this technique may therefore offer a practical strategy to reduce fracture risk.

Declaration of Interest

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Long-Term Patient Satisfaction and Understanding of Patient-Initiated Follow-Up Following Hip and Knee Arthroplasty

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Golden Jubilee University National Hospital, Glasgow City, United Kingdom

Abstract

Research Question: Patient-initiated follow-up (PIFU) pathways aim to reduce avoidable routine follow-up appointments while maintaining patient safety and satisfaction following hip and knee arthroplasty surgery. This study evaluated long-term patient understanding and satisfaction with the PIFU pathway 5 years following surgery.

Methods: A retrospective telephone questionnaire was conducted in patients discharged onto the PIFU pathway 5 years following arthroplasty surgery. Patients were assessed on awareness of the follow-up pathway, first point of contact, ease of communication, and overall satisfaction.

Results: A total of 72 patients responded to the questionnaire. At discharge, 56/72 (77.8%) patients identified the treating orthopaedic centre as their first point of contact and demonstrated understanding of the pathway, while 16/72 (22.2%) would either contact their GP, local board, or were unsure of the appropriate contact pathway. Nine patients sought additional help following discharge. Of these, 6/9 (66.7%) contacted the treating orthopaedic centre directly, while 3/9 (33.3%) either contacted their GP, local board, or were unsure of the appropriate contact pathway. At 5-year follow-up, only 30/72 (41.7%) identified the treating orthopaedic centre as their first point of contact, whereas 36/72 (50.0%) patients identified their GP as their current point of contact. Overall satisfaction with the pathway was high, with 81.9% “very satisfied” and 15.3% “satisfied”, giving an overall satisfaction rate of 97.2%. Additionally, 71/72 (98.6%) respondents stated they would recommend this pathway to others.

Conclusions: The PIFU pathway following hip and knee arthroplasty surgery demonstrated high levels of patient satisfaction and acceptable long-term engagement. Although the pathway appeared to be understood at the time of discharge, patients’ understanding of the appropriate point of contact changed over time, suggesting reduced long-term retention of pathway information. Periodic reminders may improve long-term retention and patient confidence in accessing appropriate support.

Declaration of Interest

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Tiered artificial intelligence prediction of sarcopenia risk in patients with hip or knee osteoarthritis

MINGKE YOU[1,2], JIAN LI[1], DONG WANG[2], XI CHEN[1]

[1]West China Hospital, Sichuan University, Chengdu, China. [2]University of Exeter, Exeter, United Kingdom

Abstract

Research Question: Can a tiered artificial intelligence model predict sarcopenia risk in patients with hip or knee osteoarthritis and provide an interpretable basis for personalized perioperative rehabilitation?

Methods: A binary sarcopenia risk task was defined as risk_level 1 versus risk_level 2/3. A total of 261 patients with hip or knee osteoarthritis were analysed using a fixed train/test split. LightGBM models were developed in a tiered framework. The first-layer model used routinely available clinical and functional variables; the second-layer model added laboratory variables. Performance was assessed by five-fold cross-validation and a fixed independent test set using AUC, balanced accuracy, sensitivity, specificity, F1 score, Brier score, and confusion matrix. SHAP analysis identified key predictors. Model outputs were structured for patient-facing risk communication and rehabilitation decision-making.

Results: The first-layer model achieved a test AUC of 0.871, balanced accuracy of 0.769, sensitivity of 0.680, specificity of 0.857, F1 score of 0.739, and Brier score of 0.147. Adding fasting plasma glucose and platelet count produced a 9-variable enhanced model with improved test AUC of 0.914, balanced accuracy of 0.849, sensitivity of 0.840, specificity of 0.857, F1 score of 0.840, and Brier score of 0.114. Compared with the first-layer model, AUC increased by 0.043, sensitivity by 0.160, F1 score by 0.101, and Brier score decreased by 0.033. False negatives decreased from 8 to 4, while false positives remained 4. SHAP analysis identified BMI, skeletal muscle mass, fasting plasma glucose, sit-and-reach performance, and platelet count as major predictors. Exploratory hip-specific and knee-specific models achieved test AUCs of 0.922 and 0.934, respectively.

Conclusions: A tiered artificial intelligence model accurately predicted sarcopenia risk and improved detection of higher-risk patients with osteoarthritis. At the conference, the model will be presented within an integrated workflow translating predicted risk into patient-friendly reports, individualized exercise prescriptions, prescription explanations, and reassessment-based progression or regression rules.

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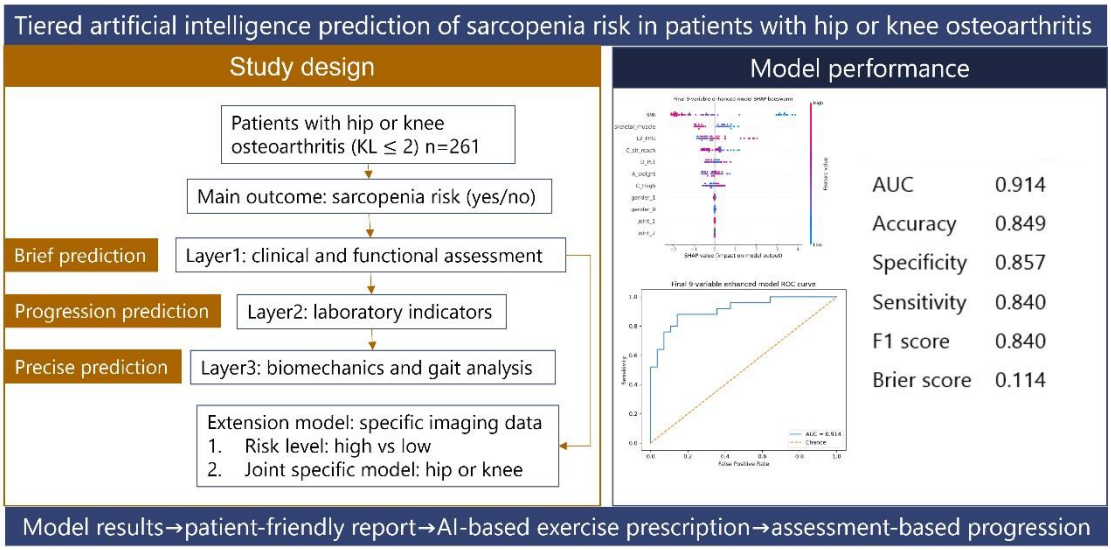

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The influence of uniform and non-uniform mechanical loading on interfragmentary motion in circular external fixators utilizing spring-loaded dynamizers

Thomas Irish[1], Hemant Sharma[2], Todd Stewart[1], Marlène Mengoni[1], Ross Muir[2], Peter Watson[1]

[1]Institute of Medical and Biological Engineering, University of Leeds, Leeds, United Kingdom. [2]Department of Trauma and Orthopaedics, Hull University Teaching Hospitals NHS Trust, Hull, United Kingdom

Abstract

Research Question: Circular external fixators provide axial interfragmentary motion (IFM) while restricting shear IFM. Controlled dynamization built into the frame struts aims to increase axial IFM, without affecting shear IFM. Frame dynamics have been measured mechanically with surrogate bone positioned concentrically in the frame (uniform loading). However, eccentric positioning, which is often more clinically relevant, and modified dynamization (both non-uniform loading) can alter frame mechanics. This study aimed to answer whether IFM increased given non-uniform loading of a dynamized circular external fixator.

Methods: An Ilizarov-style frame, including spring-loaded dynamizers, was constructed around two polycarbonate tubes with a 30 mm fracture gap. The frame was loaded under axial, torsional and bending loads with tubes positioned concentrically and eccentrically. A third configuration, with tubes concentric and struts set to varying non-uniform combinations of dynamization, was tested under axial loading only. Axial and shear IFM were optically tracked.

Results: In comparison to the concentric positioning, eccentric positioning reduced axial IFM by 2.8 mm and increased shear IFM by 0.1 mm under compression. When experiencing torsional forces, eccentric positioning increased shear IFM by up to 1.3 mm. There was negligible difference under bending loads. Non-uniform combinations of strut dynamization produced varying axial and shear IFM, under axial compression. For example, a favourable combination produced 8.3 mm axial and 0.45 mm shear motion, compared to a less favourable combination producing 6.9 mm axial and 1.1 mm shear motion.

Conclusions: The results display a reduction of axial IFM and general increase of shear IFM in non-unform loading, thus future studies should aim to replicate physiological positioning of bone within the frame. Furthermore, the combination of dynamization permitted in each strut throughout the frame alters the ratio of axial to shear motion, suggesting the potential to optimise combinations on a patient-specific level to promote faster bone healing.

Declaration of Interest

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Large Language Models for Zero-Shot Classification of Unstructured Orthopaedic Clinical Notes in Primary Knee Arthroplasty

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Abstract

Research Question :Unstructured data in electronic health records contain valuable clinical information but are difficult to standardise due to the cost and inconsistency of manual coding. Large language models (LLMs) offer a scalable approach to automatically extract structured information from clinical text, supporting registry development, audit, and research. This study evaluates how accurately LLMs can perform zero-shot classification of postoperative orthopaedic helpline notes, and how performance varies with model scale and capability in a real-world clinical setting.

Methods: We evaluated multiple state-of-the-art LLMs for zero-shot classification of postoperative helpline notes following primary knee arthroplasty. Models were tested on 100 real-world helpline notes annotated by an orthopaedic surgeon across 17 predefined categories. Model outputs were compared with reference annotations using accuracy, macro F1, and weighted F1 scores. We also explored the impact of model size and reasoning capability on classification performance.

Results: Performance varied substantially across architectures. GPT achieved the highest accuracy (0.93) and weighted F1 score (0.93), closely followed by Claude (accuracy = 0.91, weighted F1 = 0.91). Small open-source models (Qwen-0.6B, DeepSeek-1.5B, Qwen-1.7B) demonstrated reduced performance (accuracy of 0.52 - 0.75). Macro F1 scores were consistently lower than weighted F1 scores across all models indicating reduced performance in minority categories. Overall, larger models outperformed smaller models by up to 41 percentage points in accuracy, highlighting the importance of model scale and capability for clinical text classification tasks.

Conclusions: LLMs demonstrate strong potential for automated classification of orthopaedic clinical notes, offering a scalable and cost-effective alternative to manual coding for registry development. This work provides one of the first real-world evaluations of zero-shot LLM performance in orthopaedic helpline data, highlighting the importance of model selection and domain-specific optimisation to ensure safe and reliable clinical deployment. Further work will evaluate prompt engineering strategies and few-shot approaches on a larger dataset to improve minority class performance.

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Tibiofemoral contact pressure, and graft subsidence and contract pressure distribution at osteochondral graft-host interfaces in a tibiofemoral finite element model

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Abstract

RESEARCH QUESTION: Osteochondral grafts are used to treat cartilage lesions, aiming to delay osteoarthritis progression. This study evaluated how interactions at graft-host interfaces influence contact pressures and graft subsidence in osteochondral grafts, assessed using finite element models, which were validated against *in vitro* tests.

METHODS: A subject-specific finite element model was built from a porcine µCT scan, containing a femur, tibia and osteochondral graft, and validated by comparing tibiofemoral contact pressures and graft subsidence with corresponding experimental data from the same specimen, which was previously tested under the same loading conditions. The graft was computationally inserted into a recipient site on the femur, and a 1,000 N axial load was applied between the femur and tibia. Model outputs -tibiofemoral contact pressure, axial graft subsidence, maximum and summed contact pressures at graft-host interfaces (indicative of total force transfer)- were used to evaluate the effect of graft presence, graft starting position, and graft and host material properties (representing porcine or ovine bone and biomimetic synthetic materials).

RESULTS: Differences in graft and host material properties did not substantially alter tibiofemoral contact pressure distributions. Graft-host interface contact pressure after graft insertion and post-load correlated, suggesting graft stability upon insertion indicated stability under load. However, they did not correlate with maximum tibiofemoral contact pressures. Proud grafts had increased tibiofemoral contact pressures and showed increased subsidence compared to flush grafts. Host bone material had a greater impact on total and maximum contact pressures than graft material. Greater values were seen in simulated ovine host models than in porcine host models, even before tibiofemoral loading.

CONCLUSIONS: Proud grafts increase damage risk to the counterface surface. Contact pressures at graft-host interfaces were driven by material property differences, in particular of the host bone. Clinically, this indicates a need for consideration of host bone quality to promote graft stability.

Declaration of Interest

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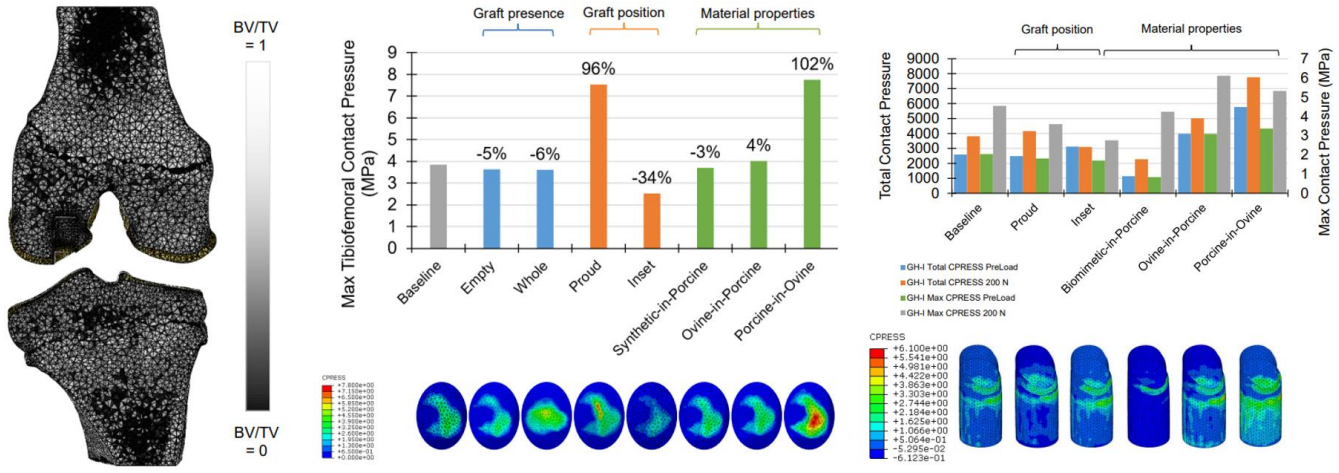

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Neuromuscular and Postural Control in Chronic Ankle Instability

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Abstract

Introduction: Chronic ankle instability (CAI) is characterised by persistent impairments in postural and neuromuscular control. This study quantified neuromuscular activity, postural sway, and dynamic balance in individuals with CAI and healthy controls.

Methods: Ten participants with CAI and ten healthy controls were included. Surface electromyography (EMG) activity of the fibularis longus, tibialis anterior, and medial gastrocnemius was recorded bilaterally using the Delsys Trigno™ Wireless System during three 10-second single-leg stance trials. Concurrent centre of pressure (COP) data were collected the Novel Emed pressure platform. EMG amplitude was normalised to maximum voluntary isometric contraction (%MVIC) and averaged across the three trials for each muscle, with group means subsequently calculated across participants. Postural sway was quantified as mean COP velocity (m/s). Dynamic balance was assessed via the Y Balance Test in the anterior, posteromedial, and posterolateral directions (three trials per direction per limb).

Results: No significant differences were observed between dominant and non-dominant limbs in controls, or between the CAI injured limb and the dominant limb of controls (all $p > .05$). However, both CAI limbs demonstrated consistently higher activation across all muscles compared with controls, with the injured limb showing the greatest activation and inter-individual variability. These differences did not reach significance, likely due to high variability and limited statistical power. Within the CAI group, COP velocity was significantly higher in the injured limb compared with the uninjured limb ($p = .028$). Despite this, both CAI limbs demonstrated lower overall COP velocity than controls, suggesting a rigid, stiffness-based postural control strategy. YBT composite scores were lower in both CAI limbs, with the greatest deficits observed in anterior reach.

Discussion: These findings indicate altered neuromuscular control and impaired dynamic balance, resulting in uncontrolled motion, in CAI, while highlighting substantial heterogeneity in compensatory strategies within this population.

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Virtual reality simulation for ankle fracture fixation: trainee attitudes and confidence outcomes

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Abstract

Research Question: Virtual reality (VR) is an emerging tool in surgical education, currently used within orthopaedics primarily for arthroscopy and arthroplasty training. Its role in orthopaedic trauma surgery remains under-explored. Ankle fracture fixation represents a high-volume, technically demanding component of orthopaedic training, and VR may offer a valuable adjunct - particularly for early-stage trainees with limited operative exposure. This study aimed to evaluate orthopaedic trainee attitudes toward VR simulation as an educational tool for ankle fracture assessment and surgical fixation planning.

Methods: Junior orthopaedic trainees (mean training duration 1.4 years, mean 9.4 cases as first-surgeon performing ankle ORIF) completed a VR simulation workshop involving fracture pattern identification and fixation planning using the Lauge-Hansen classification. Pre- and post-session confidence was recorded on a 1–10 Likert scale. Trainee attitudes were assessed through quantitative rating and qualitative thematic analysis of semi-structured feedback.

Results: Nineteen trainees participated across the workshop series. Prior VR experience was reported by 84%, with 32% having used VR in an orthopaedic context. Self-assessed confidence in ankle fracture identification improved from 3.9 to 6.4 ($p<0.05$) and confidence in ORIF planning from 3.7 to 5.7 ($p<0.05$). Overall, 61% of participants felt VR was educationally beneficial and 80% wished to see VR integrated into formal training. Thematic analysis identified three facilitators: procedural and cognitive surgical preparation, multi-modal interactive learning, and enhanced three-dimensional anatomical understanding. Three barriers were identified: absence of haptic feedback, limited biomechanical fidelity, and accessibility constraints.

Conclusion: Junior orthopaedic trainees demonstrate strong enthusiasm for VR as a training adjunct, with significant confidence gains following a single simulation workshop. VR shows promise for cognitive preparation and anatomical understanding in early training. Wider adoption will require improvements in software fidelity, haptic integration, and hardware accessibility, alongside structured investigation into how VR can be formally embedded within orthopaedic curricula.

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Arthrosamid® mechanistic and clinical trial: evaluating the utility of a patient and public involvement and engagement (PPIE) event and patient perspectives on trial involvement

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Abstract

Research Question: A prospective observational study investigating the biological pathways associated with an intra-articular polyacrylamide hydrogel injection (Arthrosamid®) as treatment for knee osteoarthritis (OA) was performed at Oswestry (RJAH). The study characterised synovial fluid (SF) biomarkers, proteomic signatures and patient reported outcome measures (PROMs) while also identifying predictors of clinical response. This quality improvement project evaluated the utility of a patient and public involvement and engagement (PPIE) event designed to re-engage participants, share study progress and explore patient perspectives on research participation and future trial design.

Methods: All remaining Arthrosamid® study participants (58/60) were invited to attend a PPIE event at RJAH in November 2025. The event included two sessions covering clinical outcomes, scientific findings and patient experience. Feedback was collected using questionnaires assessing participant satisfaction, views on research involvement and willingness to participate in future studies.

Results: Twenty-two participants attended (37.9%) with all completing feedback questionnaires. Mean overall satisfaction was 8.6/10 with 95% stating they would participate in the study again. Overall pain score for the Arthrosamid® injection was 7.3/10. Key motivations for participation included access to new treatment (95%), learning more about OA (90%), and improving health and quality of life (82%). Participants valued continued communication and expressed strong interest in contributing to dissemination of results (81%) and future trial design (73%). More than 70% were willing to participate in future research activities, while >90% would donate synovium or SF samples during outpatient procedures. If participants were approached for a study with 50/50 chance of Arthrosamid®/steroid or Arthrosamid®/placebo, patients preferred the first option (50% c.f. 23% respectively).

Conclusion: Despite discomfort associated with the Arthrosamid® injection and SF aspiration, participants reported a highly positive research experience. Continued communication and engagement between researchers and participants enhanced study involvement and highlighted the value of PPIE events in clinical research.

Declaration of Interest

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The effects of spinal fusion on facet joint biomechanics - A cadaveric study

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Abstract

Research Question: Spinal fusion is a common surgical procedure that permanently joins two or more vertebra, stabilising the spine and reducing motion related pain. It has potential to accelerate the degeneration of adjacent segments due to abnormal loading and increased movement in the unfused segments[1]. This study aimed to assess the impact of an interbody fusion device on the biomechanics of the adjacent facet joints.

Methods: Following ethical approval (REC 15/YH/0096), five human lumbar spinal segments (L4-S1) were dissected and prepared with PMMA endcaps. Mechanical testing included cyclic preloading followed by a displacement-controlled compression to 1.1 kN using a materials testing machine, with samples in a neutral position. The force-displacement relationship was recorded along with motion capture of facet joint movement and load transfer through the facet joint space due to the compressive loading. The spinal segments were tested intact, following the implantation of an interbody fusion device, and following a PMMA mock fusion[2].

Results: Implantation of the interbody fusion device caused an increase in the stiffness of the spinal segment whilst also providing a more linear force-displacement relationship. There was a large increase in facet displacement following the insertion of the fusion cage particularly at the adjacent (non-fused) facet. The facet joint force was variable for all tests due to facet degeneration impacting sensor placement however a large difference in facet force between the left and right facets was noted. Variable degeneration and tissue quality of the human tissue and aspects of the ex-vivo testing protocol limit the clinical interpretation of the results.

Conclusion: Changes in the facet displacement, load transfer and load-displacement relationship shows that spinal fusion impacts the facet joint biomechanics at the fused and adjacent levels which potentially contributes to spinal degeneration at the adjacent levels following spinal fusion surgery.

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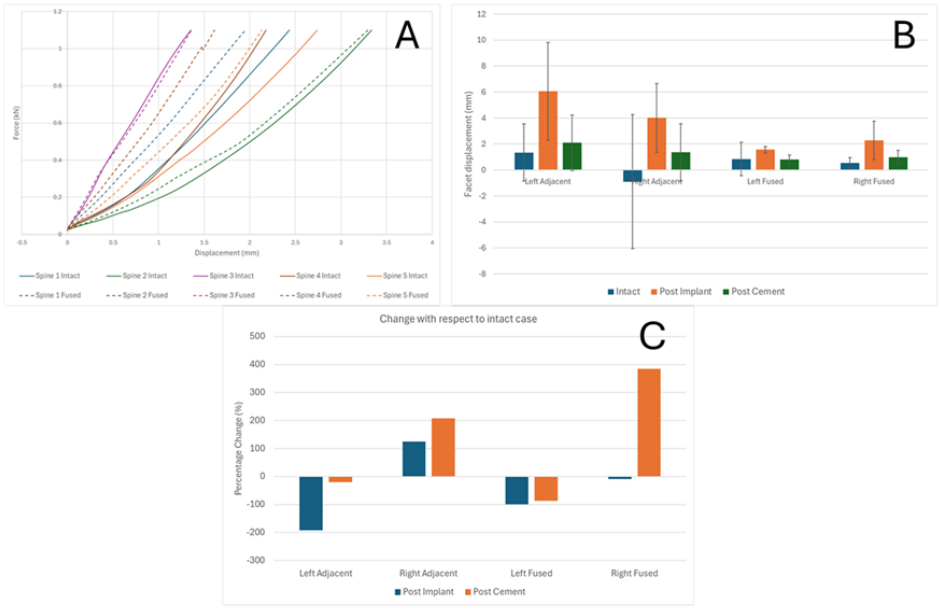

Figure 1: Outputs of cadaveric compression testing following interbody fusion. A: Force-displacement relationship during compression of five cadaveric spines pre and post fusion. B: Displacement of the facet joints during compression pre and post fusion and following a mock PMMA cement fusion. C: Facet contact force through compressive loading post fusion and following the PMMA cement fusion.

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A pilot study combining patient biomechanical data with synovial fluid-induced responses in a nociceptor model to reveal mechanically evoked osteoarthritic pain

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Abstract

Objectives: Osteoarthritis (OA) is a major cause of chronic pain. Substantial neural changes occur in OA1; physiologically silent nociceptors become activated, increasing their responsiveness to noxious, or innocuous stimuli. It is established that most OA pain is mechanically driven2, but mechanisms linking patient biomechanics and joint innervation are lacking. We compared individual osteoarthritic patients' biomechanics data with their synovial-fluid induced responses in our human nociceptor model, to reveal whether biomechanical loading altered nociceptor activity.

Methods: Human iPSC derived nociceptors were generated (Figure1A). Synovial fluid obtained from 23 (12 male, 11 female) patients undergoing total knee replacement was applied to the nociceptor model, and electrophysiological responses compared with gait biomechanics in 7 of these patients (6 male, 1 female) (Figure 1B).

Results: Female synovial fluid responses were more variable than male (Figure 1C). Synovial fluid derived from knees exhibiting greater magnitudes of stiff-knee gait and varus thrust evoked increased cumulative nociceptive activity (Figure 1D), although not significant. Knees exhibiting greater sagittal plane moments at the peak of ground reaction force evoked increased peaks in nociceptor activity ($r=0.914$, $p=0.014$).

Conclusions: There is substantial variability in nociceptor electrophysiological responses to osteoarthritic patients' synovial fluids, which was greater in females. Due to the small numbers of patients with matched biomechanics, many correlations with strong r value trends between responses within the nociceptor model and gait biomechanics were not statistically significant. However, strong correlations between knee sagittal plane moments and nociceptor activity are a novel finding and area for future investigation.

References 1. Long, H et al (2022) Arthritis & Rheumatology 74, 1172–1183. 2. Tschon et al (2021). J Clin Med 10, 3178.

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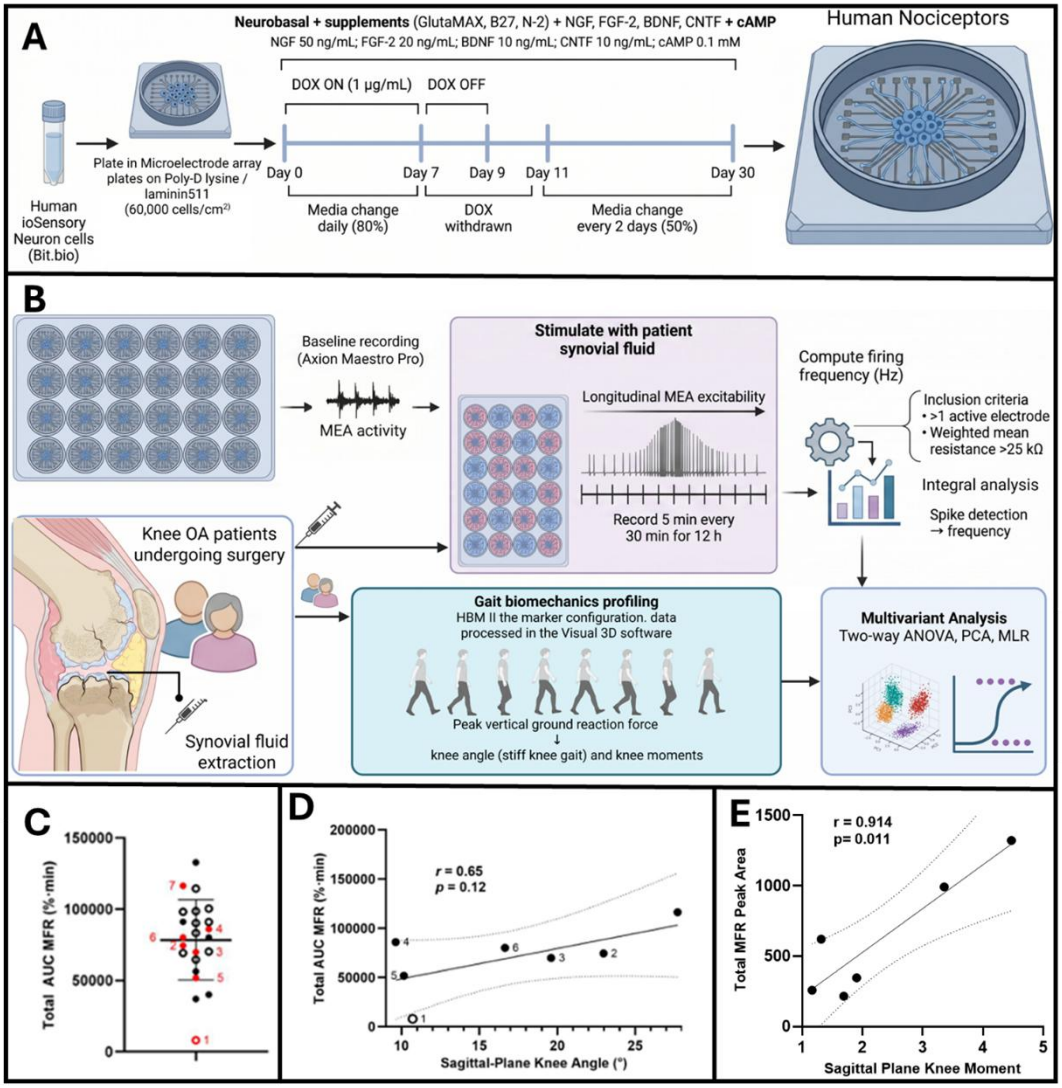

Figure 1. Methods and key results of this study (**A**) iPSC sensory neuron differentiation to nociceptor protocol. (**B**) Sensory neuron microelectrode array (MEA), gait biomechanics analysis and stimulation experimental approach. (**C**) Distribution of area under curve mean firing rate (MFR) across the full cohort (n=23) closed circles = male, open circles = female. (**D**) Correlation of Sagittal plane knee angle with total AUC firing rate and (**E**) Sagittal plane knee moment with total MFR peak area.

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Titanium Implant Hypersensitivity Reactions in Orthopaedic Surgery: A Systematic Review

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Abstract

Research Question: What is the prevalence, clinical spectrum, and optimal diagnostic and management pathway for Type IV hypersensitivity reactions to titanium orthopaedic implants?

Methods: A PRISMA-compliant systematic review searched five databases from inception through April 2026: Medline, Embase, the Cochrane Central Register of Controlled Trials, the TRIP Database, and BMJ Case Reports. Peer-reviewed studies reporting clinical or experimental data on titanium hypersensitivity in orthopaedic and trauma surgery were included. Quality was assessed using the Critical Appraisal Skills Programme tool. Sixty-six records were identified; 28 duplicates removed and four full texts were unavailable, yielding 34 included studies.

Results: Studies spanned 1991 to 2026, comprising case reports (n=22), cohort and case-control studies (n=4), reviews (n=7), and one meta-analysis. Pooled titanium sensitivity prevalence ranged from 3.2% to 5.4% in symptomatic patients, with a pooled odds ratio of 5.24 (95% CI: 3.21–8.56) for implant failure in sensitised individuals. Presentations included localised dermatitis with erythema, bullae and hyperkeratosis, sterile wound dehiscence, chronic oedema, unexplained fever, and systemic eczematous eruptions. Patch testing showed poor sensitivity due to limited dermal titanium ion penetration; the Memory Lymphocyte Immunostimulation Assay demonstrated superior sensitivity at 6.4% in symptomatic cohorts. Histopathology consistently revealed macrophage and T-lymphocyte infiltration without B-lymphocytes, confirming a Type IV mechanism. Implant removal achieved symptom resolution in the majority of cases. Co-sensitisation to vanadium, an alloying constituent of Ti-6Al-4V, was identified as a potential primary allergen in a subset.

Conclusions : Titanium hypersensitivity is a rare but clinically significant diagnosis of exclusion, complicated by overlap with fracture-related infection. A multimodal diagnostic approach incorporating lymphocyte transformation testing and histopathology is recommended. Pre-implantation screening in high-risk patients and standardised diagnostic reagents are needed to reduce diagnostic delay and revision rates.

Declaration of Interest

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The effect of exercise and physical activity on gait biomechanics and pain in people with knee osteoarthritis

Nathan Bytheway[1], Shadi Amor[1], Paul Swinton[2], Kevin Cheah[1], Andrew Morrison[3], Hasmik Jasmine Samvelyan[1]

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Abstract

Research Question: Osteoarthritis of the knee is the most prevalent type of osteoarthritis affecting 5.4million people in the UK leading to increasing healthcare costs. Exercise has been shown to help symptoms in people with knee osteoarthritis, however, there are unanswered questions about the effects of types of exercise/physical activity on mobility and pain.

Methods: A systematic review of literature was carried out to provide an evaluation and review of current literature to determine the effects of physical activity and performance of specific exercises on gait characteristics and pain in people with knee osteoarthritis. Clinical trials published in English up to 31 December 2024 were retrieved from 4 electronic databases for cross-referencing and expert review. The primary outcome measures were changes in gait biomechanics including spatiotemporal, kinematic and kinetic parameters. The secondary outcomes included changes in pain and mobility assessed through questionnaires such as Western Ontario and McMaster Universities Arthritis Index (WOMAC).

Results: Meta-analysis indicated that exercise or physical activity intervention reduced pain (effect size 0.61; 95% credible interval [CrI] 0.29 to 0.92) with significant benefits on pain reduction observed in studies that used multi-component exercise/physical activities compared with control groups. Spatiotemporal parameters such as walking speed, step/stride length and width, cadence, swing, or stance phase duration improved following the intervention (effect size 0.67; 95% credible interval [CrI] 0.27 to 1.05) whereas three-dimensional patterns of the knee joint including kinematic (effect size 0.12; 95% credible interval [CrI] -0.18 to 0.41) and kinetic (effect size -0.03; 95% credible interval [CrI] -0.25 to 0.18) changes were least affected.

Conclusions: The findings of this research may form a basis for recommendations of targeted physical activity interventions for the benefits of patients with knee osteoarthritis including pain reduction, mobility improvement and gait modification.

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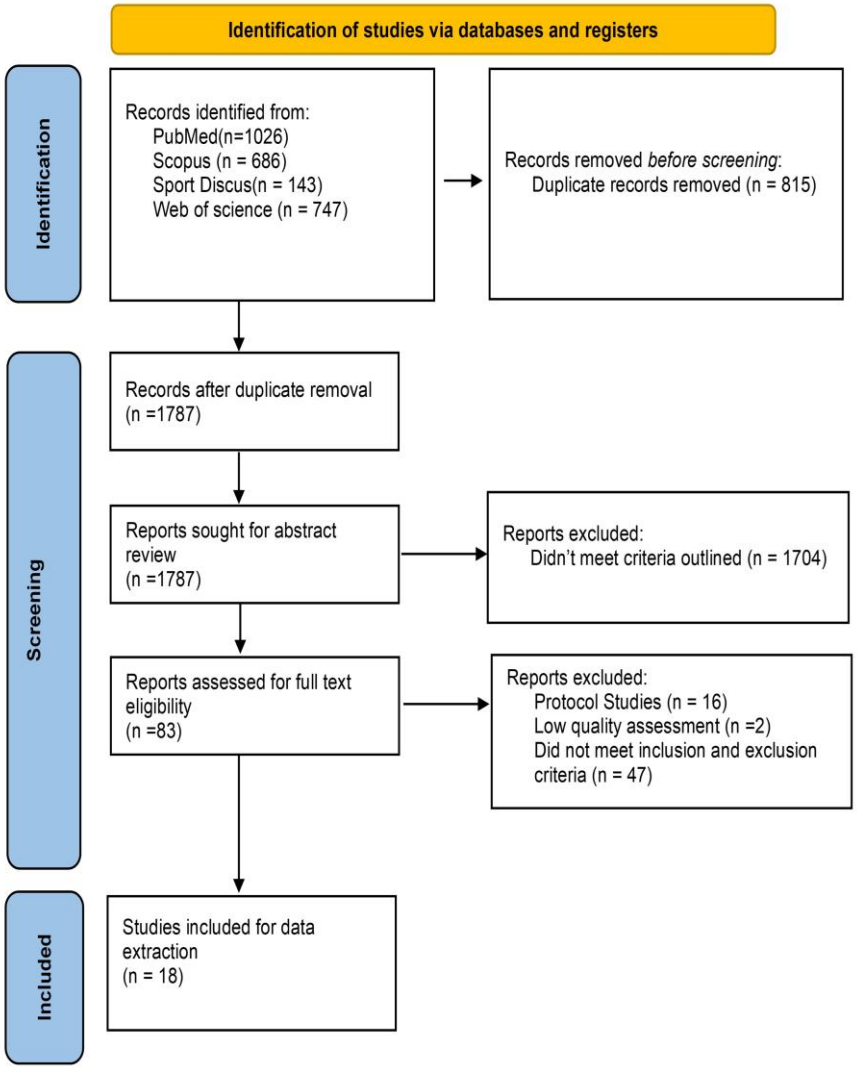

Figure 1. Search flow diagram

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A Simplified Beam Model for Rapid Assessment of Femoral Loading and Bone Adaptation

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Abstract

Background: Bone adaptation is driven by mechanical loading, with strain stimulus influencing remodelling and fracture risk, particularly in the proximal femur. However, bone mineral density does not capture spatial mechanical variations, and high-fidelity finite element models are computationally intensive. Efficient modelling approaches are therefore needed to approximate biomechanical behaviour during physiological activities. This study presents a simplified beam-element femur model integrating musculoskeletal outputs to rapidly evaluate activity-specific loading conditions via visualisation of internal forces, moments, stress and strain distributions, while supporting collaborative interpretation between researchers, clinicians and patients, towards identifying osteogenic activities beneficial for reducing fracture risk.

Methodology: A simplified beam model of the femur was developed in Rhino/Grasshopper. Femoral geometry was extracted to derive cross-sectional properties for a hundred slices along the femoral centreline.Musculoskeletal model-derived joint contact and muscle forces were applied as loads to the beam model to compute nodal displacements and internal forces. Outputs included axial and shear force, bending and twisting moment distributions, together with the resulting stress and strain distributions.

Preliminary Results: The simplified beam model provides comparable results to more complex continuum finite element models of the femur, with around a 1000-fold decrease in computational run times.

Discussion and Conclusion: Fractures resulting from side falls are associated with a reversal of the bending moment at the femoral neck; therefore, walking alone may not provide sufficient protection. Compared with continuum finite element models, the beam model enables near real-time visualisation for immediate assessment and comparison of activity-specific loading patterns. Strain distribution output allows rapid identification of activities inducing elevated osteogenic strains at fracture-prone regions, supporting bone adaptation and serving as an effective communication tool to guide activity selection for promoting bone health in these regions. By modifying loading and boundary conditions, the model can also be applied for rapid fracture prediction.

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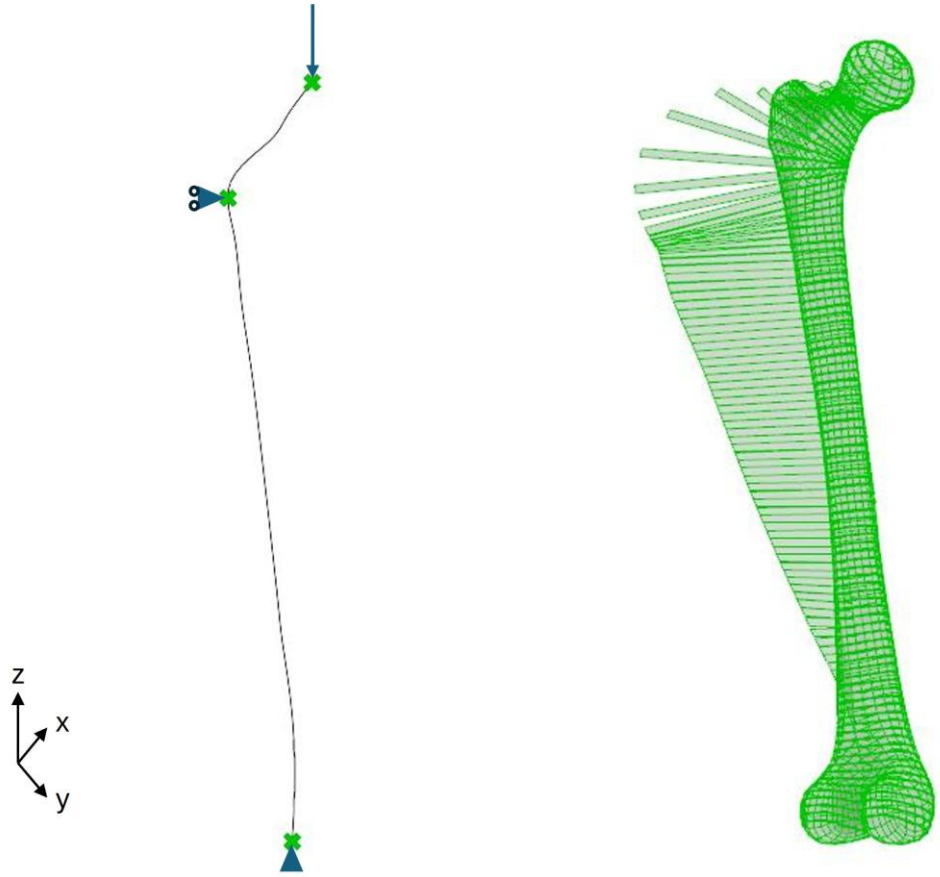

Figure 1. (A) Simplified femoral beam model showing the femoral centreline with idealised preliminary loading and boundary conditions highlighted in green. A vertical downward point load of 2000 N is applied at the proximal node, while the leftmost proximal node is constrained using a roller support and the distal node is constrained using a pin support. (B) Distribution of bending moment M_y visualised along the femoral centreline and overlaid with the femoral geometry outline.

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Functional recovery and radiographic findings following total hip arthroplasty with 3D-printed acetabular cups: a systematic review and meta-analysis

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Abstract

Research Question: Three-dimensional (3D)-printed acetabular cups are designed to improve biological fixation through enhanced porous architecture and surface characteristics. However, whether these radiographic advantages translate into superior functional recovery after total hip arthroplasty (THA) remains uncertain. This study evaluated functional recovery and radiographic findings associated with 3D-printed acetabular cups following THA.

Methods: A systematic review and meta-analysis following PRISMA guidelines was conducted using PubMed, Embase, Web of Science, and Scopus up to March 2025. Studies reporting Harris Hip Score (HHS) outcomes after THA using 3D-printed acetabular cups were included. Functional improvement was assessed using HHS change from baseline to final follow-up. Comparative studies between 3D-printed and conventional cups were analysed separately. Radiographic fixation and osseointegration outcomes were synthesised narratively.

Results: Ten studies involving 443 hips were included. THA using 3D-printed cups demonstrated marked postoperative functional recovery, with a pooled HHS increase of 45.93 points (95% CI 38.54–53.31). Radiographic findings consistently showed favourable early fixation, high osseointegration rates, and minimal progressive radiolucent lines. However, pooled analysis of three comparative studies (197 hips) showed no statistically significant functional advantage over conventional cups (MD 6.95; 95% CI −13.12 to 27.01). This discrepancy between radiographic fixation and patient-reported outcomes may reflect the limited sensitivity of HHS to detect implant-related biomechanical and osseointegration advantages during short- to mid-term recovery.

Conclusions: 3D-printed acetabular cups appear to provide reliable early biological fixation, favourable radiographic stability, and substantial functional improvement following THA. However, current comparative evidence remains insufficient to confirm superior short- to mid-term functional outcomes versus conventional cups. Potential advantages of 3D-printed designs may be more apparent from implant microarchitectural and biomechanical perspectives than from short-term functional scores alone. Further prospective comparative studies integrating radiographic, functional, biomechanical, and survivorship outcomes are required.

Declaration of Interest

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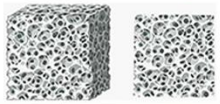
Functional recovery and radiographic findings following THA with 3D-printed acetabular cups

KEY QUESTION: Do improved implant microarchitectural properties translate into superior functional recovery?

IMPLANT MICROARCHITECTURE

3D-Printed Acetabular Cup



3D-Printed (Porous)	Conventional (Solid)
Trabecular-like porous structure	Solid structure
Pore size 600–800 µm	No pores
Elastic modulus closer to cancellous bone	Higher elastic modulus
Higher friction coefficient (initial stability)	Lower friction coefficient
Enhanced bone ingrowth & vascularization	Limited bone ingrowth

Designed to enhance biological fixation while maintaining mechanical stability

RADIOGRAPHIC FINDINGS

Consistently favourable early fixation across included studies

High osseointegration >90%
in most studies

Minimal cup migration
Stable radiographic alignment

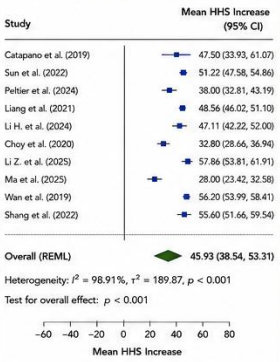
Non-progressive radiolucent lines
Low incidence and non-progressive

Survivorship >95%
across available follow-up

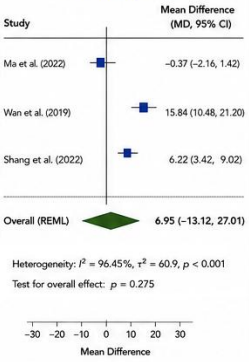
Radiographic evidence consistently supports implant stability

FUNCTIONAL OUTCOMES (HHS)

META 1: Overall improvement (Within-group analysis)



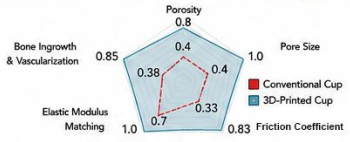
META 2: 3D-Printed vs Conventional (Direct comparisons)



No statistically significant functional superiority
MD 6.95; 95% CI −13.12 to 27.01; p = 0.275; i^2 = 96.45%

HHS may not fully capture implant-level biomechanical and osseointegration advantages during postoperative recovery

Literature-derived conceptual comparison of implant properties*



*Values are conceptual and derived from literature-reported parameter ranges rather than pooled quantitative analysis.

STUDY FLOW (PRISMA 2020)

247	162	35	127	10	443
Records identified	Records screened	Full texts assessed	Records excluded	Studies included	Hips analysed

Databases: PubMed, Embase, Web of Science, Scopus

KEY TAKEAWAYS

- 3D-printed cups provide reliable early fixation and favourable radiographic stability across included studies.
- Current evidence does not confirm superior functional outcomes versus conventional cups.
- Future studies should integrate radiographic, functional, and survivorship outcomes.

Continuous but Not Categorical Body Mass Index Is Associated with Complications Following Primary Total Hip Arthroplasty: A Single-Centre Study of 2,865 Patients

Swati Chopra[1], Meraj Akhtar[1], Glory Abugu[2,1], Nicholas Holloway[1], Rohit Maheshwari[1]

[1]NHS Golden Jubilee, Glasgow, United Kingdom. [2]University of Strathclyde, Glasgow, United Kingdom

Abstract

RESEARCH QUESTION: Rigid body mass index (BMI) thresholds continue to restrict access to total hip arthroplasty (THA) despite limited evidence that BMI independently predicts adverse outcomes after adjustment for comorbidity. Does BMI, analysed as a continuous versus categorical variable (≥35 kg/m²), independently predict complications, revision, or mortality following primary THA?

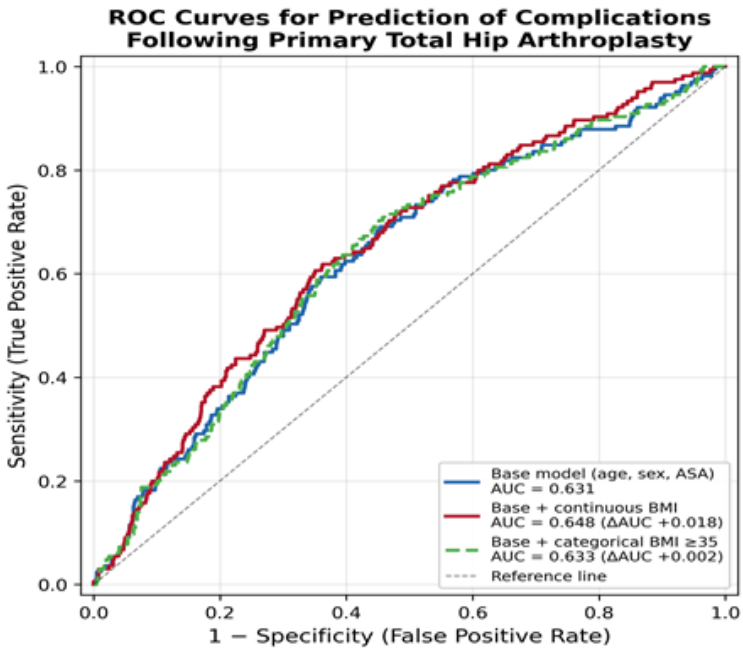
METHODS: A retrospective analysis of 2,865 consecutive primary THAs at a high-volume national elective orthopaedic centre (April 2021 to March 2023) was performed. Patients were stratified by BMI <35 (n=2,415) and ≥35 kg/m² (n=450). Sequential logistic regression models (unadjusted; age- and sex-adjusted; age-, sex-, and ASA-adjusted) evaluated BMI as both a continuous and categorical predictor. Discriminative performance was assessed using receiver operating characteristic (ROC) analysis. Kaplan–Meier survival analysis and patient-reported outcome measures (PROMs) were compared.

RESULTS: Complication rates (6.2% vs 5.7%, p=0.659), revision (2.0% vs 1.6%, p=0.548), and mortality (2.7% vs 2.3%, p=0.615) did not differ between groups. Categorical BMI ≥35 was not a significant predictor of any adverse outcome at any adjustment level. Continuous BMI was associated with complications after full adjustment (OR 1.05, 95% CI 1.02–1.09, p=0.003), but associations with revision (OR 1.04, p=0.173) and infection-related revision (OR 1.08, p=0.063) were attenuated and lost significance after ASA adjustment. ROC analysis demonstrated poor discriminative ability: adding continuous BMI to a clinical model (age, sex, ASA) improved discrimination marginally (ΔAUC +0.018), while categorical BMI ≥35 provided no meaningful improvement (ΔAUC +0.002) (Figure 1). Satisfaction was comparable at one year.

CONCLUSIONS: Categorical BMI ≥35 does not predict adverse outcomes following primary THA. While a modest continuous association with complications exists, BMI lacks discriminative ability to function as a surgical threshold, and associations with revision are mediated by comorbidity burden. These findings argue against rigid BMI cutoffs and support individualised risk assessment incorporating shared decision-making and perioperative optimisation.

Declaration of Interest

(b) declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported:I declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research project.



104

Metabolic activation enhances osteoblast function but impairs differentiation in PAR2-deficient bone cells

Alexandros Lamprou, Patricia Riedlova, Carl Goodyear, John Cole, Carmen Huesa

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Abstract

Research Question: Protease-activated receptor-2 (PAR2) is a G protein-coupled receptor implicated in skeletal homeostasis, inflammation, and tissue remodelling. Emerging evidence suggests roles in osteoblast differentiation, but its function during early lineage transitions and its integration with cellular metabolism remain unclear. We hypothesised that PAR2 regulates metabolic state, which independently influences lineage allocation and osteoblast functional output.

Methods: Bone marrow cultures from wild-type (WT) and PAR2^{-}/$^{-}$ mice were cultured under osteogenic conditions and analysed at day 0 and day 3 by bulk RNA sequencing. Cell-state composition was inferred using CIBERSORTx. Differential expression analyses focused on ossification and metabolic pathways. Primary osteoblasts were assessed using Seahorse assays to quantify extracellular acidification rate (ECAR) and oxygen consumption rate (OCR) under PAR2 activation and inhibition conditions.

Results: PAR2^{-}/$^{-}$ bone marrow cultures retained early osteogenic gene expression (Runx2, Alpl, Ibsp, Sfrp1/2 and Pth1r) but showed reduced induction of Bglap, indicating impaired maturation. CIBERSORTx analysis revealed altered lineage allocation, with MALP/adipocyte-like cells increasing to ~30% in PAR2^{-}/$^{-}$ cultures compared to ~20% in WT, alongside reduced osteoprogenitors (~25% vs ~30%). This was supported by induction of lipid metabolism genes (Adipoq, Adrb1/3, Cpt1c, Cpt2, Scd1 and Plin1) and reduced Cox5b expression. Seahorse analysis showed increased glycolysis in PAR2^{-}/$^{-}$ osteoblasts, with higher ECAR (P.adj = 0.049). Pharmacological PAR2 inhibition in WT cells similarly increased ECAR, whereas PAR2 activation with 2-Furoyl-LIGRLO-amide reduced both OCR (P.adj = 0.037) and ECAR (P.adj = 0.035). ATP-linked respiration increased by 21.4% in PAR2^{-}/$^{-}$ osteoblasts. Despite impaired maturation, PAR2^{-}/$^{-}$ osteoblasts exhibited faster mineralisation.

Conclusions: PAR2 restricts a high-capacity metabolic state during osteogenic differentiation. Its loss promotes increased glycolysis and ATP production, enhancing mineralisation while disrupting differentiation and favouring adipocyte-like lineage features. These findings show that the same metabolic profile can drive osteoblast function while impairing differentiation.

Declaration of Interest

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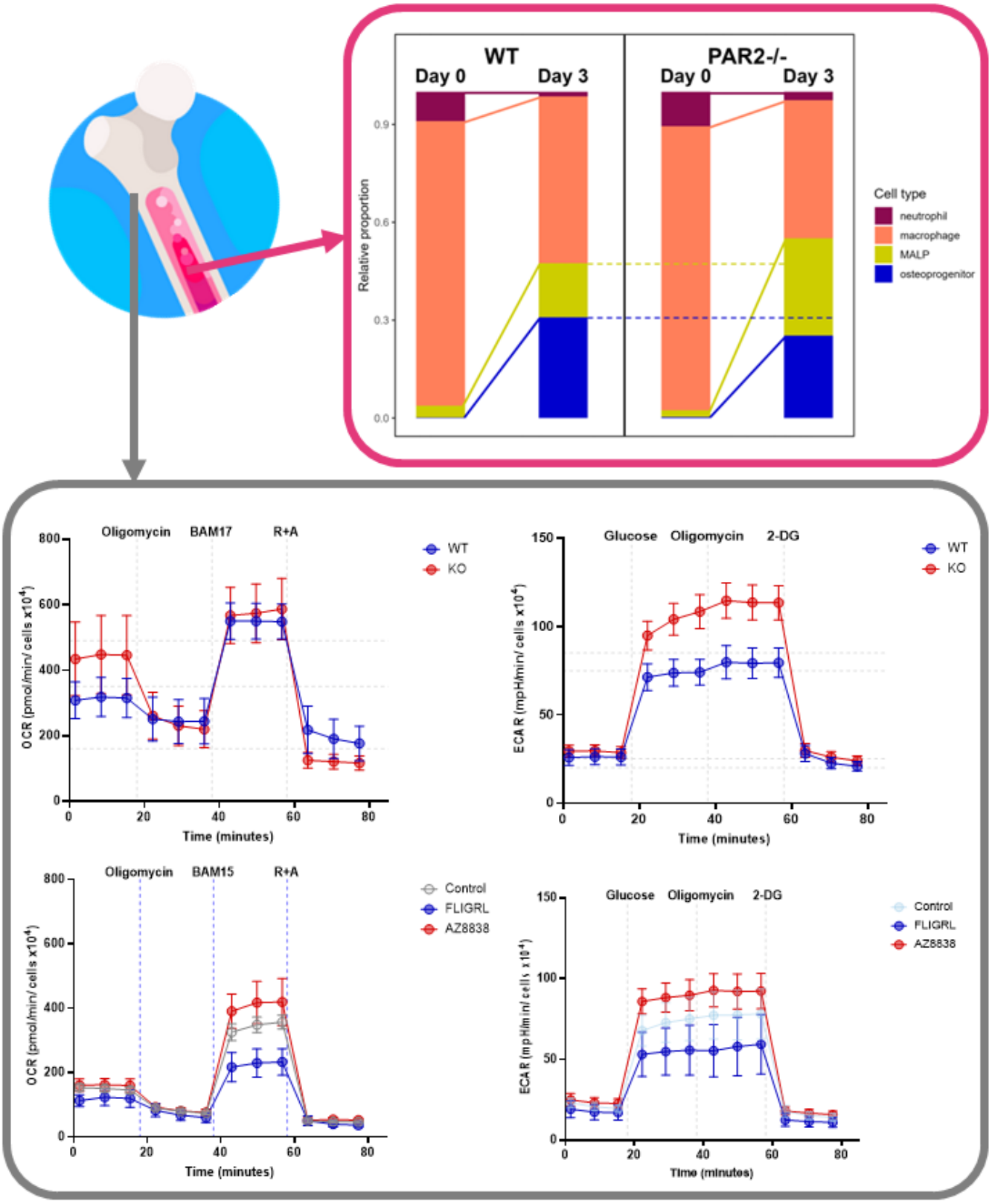
WT
Day 0
Day 3
PAR2-/-
Day 0
Day 3
Relative proportion
0.9
0.6
0.3
0.0
Cell type
neutrophil
macrophage
MALP
osteoprogenitor
Oligomycin
BAM17
R+A
OCR (pmol/min/ cells x10⁴)
800
600
400
200
0
0
20
40
60
80
Time (minutes)
WT
KO
Glucose
Oligomycin
2-DG
ECAR (mpH/min/ cells x10⁴)
150
100
50
0
Time (minutes)
WT
KO
Oligomycin
BAM15
R+A
OCR (pmol/min/ cells x10⁴)
Time (minutes)
Control
FLIGRL
AZ8838
Glucose
Oligomycin
2-DG
ECAR (mpH/min/ cells x10⁴)
Time (minutes)
Control
FLIGRL
AZ8838

106

Early functional biomechanical assessment predicts long-term patient-reported outcomes following cementless total knee arthroplasty: a prospective study with five-year follow-up

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Abstract

RESEARCH QUESTION: Can functional biomechanical assessment at one year following cementless total knee arthroplasty predict long-term patient-reported outcomes?

METHODS: Patients with complete pre- and post-operative biomechanical assessment and patient-reported outcomes were analysed from a prospective cohort of 100 primary TKAs using the Triathlon cementless system with Tritanium tibial baseplate. Three-dimensional gait and step-up tasks were assessed pre-operatively and at one year. Oxford Knee Score and EQ-5D-5L were collected pre-operatively and at one, three, and five years. Spearman correlations assessed whether one-year biomechanical changes predicted three- and five-year PROMs. Wilcoxon tests with FDR correction compared pre- and post-operative kinematics.

RESULTS: Fifty-eight patients had complete gait data and 44 had complete step-up data, with three- and five-year PROMs available for 55 and 37 respectively. OKS improved from 19.3±7.6 to 39.9±8.4 at one year and was maintained at three years (41.3±8.1, n=55) and five years (40.0±9.9, n=37). Surgery resolved pre-operative knee sagittal gait asymmetry between limbs, while new pelvis compensation strategies emerged. One-year biomechanical improvements predicted absolute long-term PROMs (Table 1). Step-up knee sagittal ROM change was the strongest predictor of five-year EQ-5D health state (r=0.59, p=0.001) and OKS (r=0.51, p=0.006). During gait, hip and pelvis sagittal ROM changes predicted both three- and five-year outcomes, suggesting proximal compensatory strategies carry prognostic value.

CONCLUSIONS: Functional biomechanical assessment at one year following cementless TKA predicts patient-reported outcomes at three and five years. Step-up knee ROM and hip and pelvis kinematics during gait carry independent prognostic value, supporting biomechanical assessment as a tool for early identification of patients at risk of poorer long-term outcomes.

Declaration of Interest

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Table 1: One-year biomechanical change predicting three- and five-year PROMs

Biomechanical variable	Outcome	r	p	n	Sig
Step-up knee sag ROM	EQ-5D HS 5yr	0.59	0.001	28	**
Step-up knee sag ROM	OKS 5yr	0.51	0.006	28	**
Step-up knee sag ROM	EQ-5D HI 5yr	0.45	0.016	28	*
Step-up knee sag ROM	OKS 3yr	0.37	0.017	41	*
Step-up knee sag ROM	EQ-5D HS 3yr	0.34	0.031	41	*
Gait hip sag ROM	EQ-5D HI 5yr	0.50	0.002	37	**
Gait hip sag ROM	EQ-5D HI 3yr	0.34	0.021	45	*
Gait hip sag ROM	OKS 5yr	0.33	0.047	37	*
Gait pelvis sag ROM	OKS 3yr	0.34	0.011	55	*
Gait pelvis sag ROM	OKS 5yr	0.40	0.013	37	*
Gait pelvis sag ROM	EQ-5D HS 5yr	0.39	0.018	37	*

Spearman correlations. Core cohort: 58 patients with complete pre- and post-operative biomechanical and PROMs data.
** p<0.05, ** p<0.01 (shaded). HS = Health State, HI = Health Index. Sag = sagittal. ROM = range of motion. OKS = Oxford Knee Score.*

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Impacts of mixing techniques and vacuum levels on the structural and mechanical properties of PMMA bone cement

Harry Barratt[1], Harry Templeman[2], Karthik Nair[2], Gavin Day[1], Anthony Herbert[1]

[1]Institute of Medical and Biological Engineering, University of Leeds, Leeds, United Kingdom. [2]Summit Medical Ltd., Cheltenham, United Kingdom

Abstract

Research Question: Polymethyl methacrylate (PMMA) bone cement is widely used for fixation of orthopaedic implants. However, porosity introduced during cement preparation may compromise mechanical performance and contribute to implant loosening. Previous studies have shown that vacuum-assisted mixing can reduce cement porosity and improve mechanical behaviour [1,2]. Vacuum-assisted mixing systems aim to reduce porosity, but limited studies have quantitatively compared clinically relevant mixing systems using three-dimensional imaging techniques. This study investigated how different PMMA mixing systems and vacuum levels influence cement porosity and mechanical performance.

Methods: PALACOS® MV PMMA bone cement specimens were prepared using open bowl, vacuum bowl, and vacuum cartridge mixing systems. Vacuum-assisted systems were evaluated at 0, 250, 550, and 650 mmHg. Cylindrical specimens (Ø6 mm × 12 mm) were produced in accordance with ISO 5833:2002. Structural properties were assessed using specimen mass measurements and high-resolution micro-computed tomography (µCT) to quantify three-dimensional porosity. Compressive testing was also performed in accordance with ISO 5833:2002 to determine the strength and Young's modulus. Statistical analysis assessed differences between groups and correlations between porosity and mechanical performance.

Results: High-vacuum mixing significantly reduced porosity compared to atmospheric mixing conditions. Vacuum bowl mixing at 650 mmHg produced significantly lower porosity than open bowl mixing, while the vacuum cartridge system also demonstrated reduced porosity at higher vacuum levels. A strong negative correlation was identified between porosity and compressive strength ($R^2 = 0.864$, $p < 0.05$). Specimen mass was not predictive of mechanical performance. No significant differences in Young's modulus were observed between groups.

Conclusions: PMMA cement porosity is strongly influenced by mixing technique and vacuum level, with high-vacuum mixing reducing void formation and improving compressive strength. µCT-derived porosity measurements provided superior prediction of mechanical performance compared with mass-based assessment methods. References: 1. Zivic et al.,2012. JMBBM. 5:129-138.2. Dunne and Orr, 2001. Biomaterials. 22:819-1826.

Declaration of Interest

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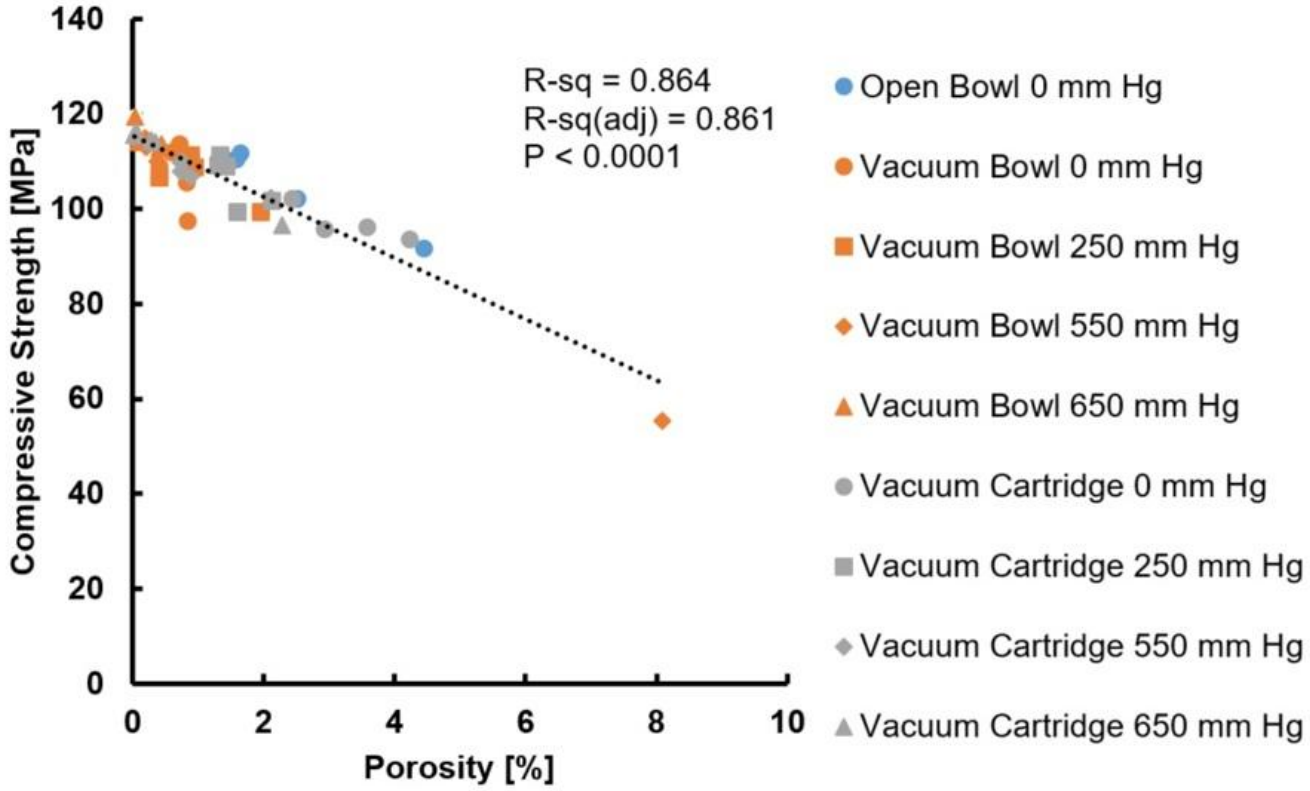

Plot of compressive strength versus porosity for all the specimens investigated in all test groups. A regression analysis demonstrated a strong and significant correlation.

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Multivariate State Space Analysis of Gait: High-Dimensional Measures of Complexity and Variability

Philip Riches[1], Jon Clarke[2], Fahd Mahmood[2], David Wallace[2], Lauren Forsyth[3]

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Abstract

Univariate delay-embedding techniques have frequently been employed to reconstruct gait state spaces and differentiate between experimental groups. However, metrics such as the largest Lyapunov exponent and correlation dimension have seen limited translation into clinical practice. Constructing state spaces from multivariate joint kinematic data offers comparable analytical capability while potentially enhancing clinical interpretability, avoiding the assumptions of Takens' theorem. Research Question. We propose a set of novel multivariate measures to characterise the complexity and variability of n-dimensional cyclic motion, with specific application to gait analysis.

Methods: Within this high-dimensional state space, measures such as mean path length and path tortuosity are used to quantify movement complexity, while variability is assessed through both stride-to-stride fluctuations and a global measure of state space dispersion. To demonstrate the utility of these metrics, lower-limb kinematics are analysed holistically within an 18-dimensional framework, comprising the three joint angles of the ankle, knee, and hip bilaterally. This representation preserves inter-joint dependencies and temporal coordination patterns that are inherently lost in univariate or lower-dimensional approaches, enabling a more comprehensive characterisation of locomotor dynamics. The proposed measures are evaluated across 11 younger adults, 14 older adults, and 7 individuals following total knee arthroplasty.

Results: A key finding is that the ratio of stride-to-stride variability to overall state space variability is significantly reduced with ageing and following arthroplasty. This suggests a compensatory adaptation in gait, whereby individuals subconsciously regulate movement to enhance local joint stability within the bounds of intrinsic variability.

Conclusions: These findings demonstrate the potential of multivariate, high-dimensional state space analysis to provide sensitive and clinically meaningful insights into gait organisation. This approach may support the development of robust biomechanical markers for identifying and monitoring pathological gait and joint instability in clinical populations.

Declaration of Interest

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Cost of Hip Spica Versus DF2 Bracing in Paediatric Femoral Fractures: A Service Evaluation

Varun Ambagade, Minh Nguyen, Sheena Seewoonarain

Evelina London Children's Hospital, London, United Kingdom

Abstract

Background: Hip spica casting is the standard treatment for paediatric femoral shaft fractures but requires substantial healthcare resources, including theatre time, general anaesthesia, and inpatient admission. The DF2® brace may provide a cost-effective alternative. This service evaluation compared the total cost of hip spica management with the estimated cost of DF2® brace application.

Methods: A retrospective audit was conducted at Evelina London Children's Hospital involving children with isolated femoral fractures treated with hip spica casting over three years, excluding cases with safeguarding concerns. Data collected included theatre time, inpatient stay, estimated theatre and ward costs, and documented complications or re-interventions. Total hip spica treatment costs were compared with the estimated cost of standard DF2® brace application.

Results: Six patients were included (6 males; mean age 31 months, range 16 months–5 years). Five patients sustained femoral shaft fractures (4 transverse, 2 oblique), and one sustained a femoral neck epiphyseal fracture. Fractures were right-sided in one case and left-sided in five cases.Mean inpatient stay, including pre- and post-operative admission, was 32.5 hours (range 5–73 hours). Mean theatre time was 1.49 hours (range 1–2.5 hours). One patient required re-intervention following diarrhoea-associated skin breakdown requiring hip spica window opening.Hip spica management required theatre intervention and inpatient admission in all cases, generating an overall treatment cost of approximately £4,070. Estimated DF2® bracing costs were substantially lower at approximately £1,500, as braces can be applied directly in the Emergency Department by the orthopaedic on-call team. Cost savings were primarily attributable to avoiding theatre use and reducing inpatient ward stay.

Conclusion: DF2® functional bracing appears to be a viable alternative to hip spica casting, with potential to reduce costs and alleviate pressure on theatre and inpatient services. Prospective studies are required to validate these findings and assess long-term clinical outcomes within comparable paediatric fracture populations.

Declaration of Interest

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A Ternary Composite Scaffold Consisting of Arg-CDs, SIS Hydrogel and Aligned PCL Membrane for High-Quality Healing of Achilles Tendon Rupture

Liwei Yao[1], Zheyu Yao[2], Xufeng Mao[2], Haijiao Mao[2], Wenmiao Shu[3], Hongtao Zhang[4]

[1]the first affiliated hospital of Ningbo University, Ningbo, United Kingdom. [2]the first affiliated hospital of Ningbo University, Ningbo, China. [3]University of strathcylde, glasgow, United Kingdom. [4]Soochow University, Su, China

Abstract

Research Question: Achilles tendon rupture affects 2.5 per 100,000 people annually, with a re-rupture rate up to 6.8% and healing time over 12 weeks. Poor vascularization, excessive inflammation, peritendinous adhesion, and insufficient mechanical support lead to unsatisfactory outcomes. Conventional therapies cannot address these problems simultaneously. This study investigated whether a ternary composite scaffold (CD@SIS@PCL) integrating arginine-functionalized carbon dots (Arg-CDs), SIS hydrogel, and aligned PCL membrane can synergistically improve high-quality Achilles tendon repair.

Methods: Arg-CDs were prepared via hydrothermal synthesis. Thermosensitive SIS hydrogel served as a bioactive matrix and sustained-release carrier, while aligned electrospun PCL membrane provided mechanical support and anti-adhesion barrier. In vitro, we assessed TDSC proliferation, migration, cytoskeletal extension, HUVEC tube formation, and IL-6/TGF-β expression under LPS stimulation. In vivo, SD rats were randomized into sham, rupture, PCL, and CD@SIS@PCL groups. Outcomes included adhesion scoring, blood perfusion, histology, SCX/TNMD/VEGF/PDGF expression, biomechanics (maximum load, stiffness, Young's modulus), and AFI at 1, 4, and 8 weeks.

Results: In vitro, CD@SIS significantly enhanced TDSC activity and angiogenesis, reduced IL-6, and increased TGF-β ($p<0.05$). In vivo, CD@SIS@PCL markedly lowered adhesion scores, improved blood perfusion and collagen alignment, and upregulated SCX, TNMD, VEGF, and PDGF expression ($p<0.05$). At 8 weeks, maximum load, stiffness, and Young's modulus were significantly higher than in rupture and PCL groups, and AFI scores approached normal sham levels, indicating effective functional recovery.

Conclusions: CD@SIS@PCL integrates anti-inflammation, pro-angiogenesis, cell recruitment, mechanical protection, and anti-adhesion functions. It significantly improves histological, biomechanical, and functional recovery in a rat Achilles tendon rupture model. This multifunctional scaffold offers a promising, clinically translatable strategy for high-quality repair of acute Achilles tendon rupture.

Declaration of Interest

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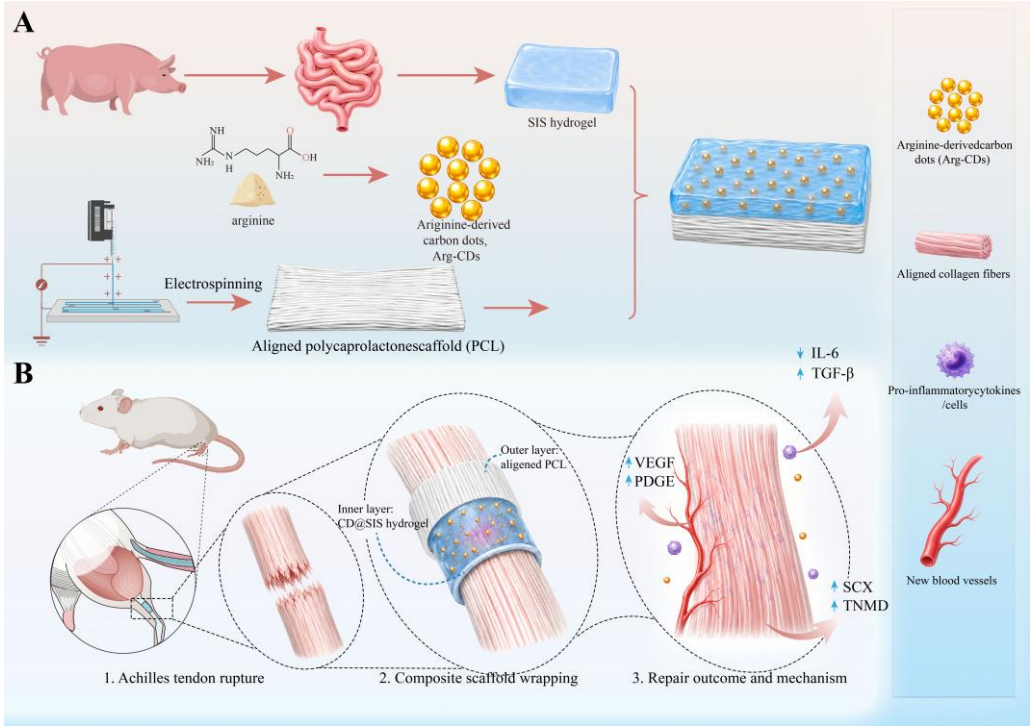
A
SIS hydrogel
arginine
Ariginine-derived carbon dots, Arg-CDs
Electrospinning
Aligned polycaprolactonescaffold (PCL)
Arginine-derivedcarbon dots (Arg-CDs)
Aligned collagen fibers
Pro-inflammatorycytokines /cells
New blood vessels
B
IL-6
TGF-β
Outer layer: aligened PCL
Inner layer: CD@SIS hydrogel
VEGF
PDGE
SCX
TNMD
1. Achilles tendon rupture
2. Composite scaffold wrapping
3. Repair outcome and mechanism

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The use of shearwave elastography to evaluate knee synovial stiffness following hydrogel injection: an exploratory study

David Hamilton[1], Lisa Wright[1], Diane Dickson[2], Graeme Hopper[3]

[1]Glasgow Caledonian University, Glasgow, United Kingdom. [2]NHS Education Scotland, Glasgow, United Kingdom. [3]NHS Lanarkshire, Glasgow, United Kingdom

Abstract

Research Question: Injectable polyacrylamide hydrogel (iPAAG) is a new class of treatment for knee OA; an implantable device that integrates with the synovium. We performed an exploratory study to evaluate whether shearwave elastography (SWE) could measure synovial stiffness in patients receiving the hydrogel.

Method: Eight individuals with knee OA were recruited and scanned prior to and following iPAAG injection (Arthrosamid®, Contura International Ltd). Hydrogel injections were performed by a single surgeon. Repeat scans were performed 6-months post-injection. SWE was evaluated using a Samsung V8 ultrasound system via a high-frequency linear probe (10-18 MHz) with elastography capability. The knee was scanned in longitudinal, transverse and oblique planes. The synovial membrane was identified and 3x regions of interest were marked in each view. These same regions were found at re-scan and corresponding measurements taken. A summed mean SWE value is reported in Kpa. Clinical symptoms were monitored with a battery of patient reported outcomes.

Results: Seven individuals presenting with varying stages of knee OA returned for follow-up assessment. In the seven paired observations, total mean synovial stiffness decreased from 71.52 ± 27.11 kPa at baseline to 65.40 ± 28.76 kPa following intervention. The overall change was not statistically different (mean difference −6.12 ± 31.98 kPa, ,). Individuals however, demonstrated marked variability: three demonstrated reduced stiffness (mean change −33.37 ± 25.16 kPa), three increased stiffness (mean change +18.89 ± 14.60 kPa, and one no change (-0.64 kPa). The synovial stiffness changes detected correlated directly with change in patient symptoms and ongoing treatment preferences.

Conclusions: While caution is advised interpreting the change in specific SWE Kpa values for synovial stiffness, that we were able to discriminate between those that had a positive and negative response to treatment suggests this as a promising methodology to monitor the integration of the hydrogel with the synovium.

Declaration of Interest

(a) fully declare any financial or other potential conflict of interest

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Vitamin D deficiency and risk of Charcot Foot: A Systematic Review

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Abstract

Background: Charcot foot is a serious musculoskeletal complication of diabetes characterised by progressive joint destruction in a neuropathic foot. Its pathophysiology is multifactorial, involving loss of protective sensation and subsequent mechanical microtrauma, abnormal bone remodelling and chronic inflammation. Although vitamin D plays a key role in bone health, research exploring the relationship between vitamin D deficiency and the development of Charcot foot is limited.

Objectives: To systematically review the existing literature assessing whether vitamin D deficiency is associated with the development of Charcot foot in patients with diabetes mellitus.

Methods: A systematic review was conducted of PubMed/MEDLINE, Embase and Web of Science in January 2026. Studies including diabetic adults with a clinical or radiological diagnosis of Charcot foot which measured serum 25-hydroxyvitamin D levels were included. No restrictions were applied to study design, setting or publication date. Search terms combined vitamin D and Charcot foot-related key words.

Results: 4 studies (n = 268) met inclusion criteria, including 3 cross-sectional observational studies and 1 retrospective observational study conducted in the USA and Russia. Prevalence of vitamin D deficiency and insufficiency was high throughout all groups, with mean vitamin D ranging from 12.1 to 26.73ng/mL. 2 studies showed lower vitamin D levels in patients with Charcot foot compared to those without (20.3 vs 21.6ng/mL; 14.08 vs 17.38ng/mL) however results were not statistically significant ($p = 0.55$; $p = 0.509$). No study demonstrated a statistically significant association between vitamin D deficiency and Charcot foot.

Conclusions: Current evidence does not demonstrate an independent association between vitamin D and Charcot foot. However, vitamin D's role in musculoskeletal health and potential roles in neuropathy and glycaemic control suggest biological plausibility. Evidence is limited by small, observational studies with restricted geographic diversity, highlighting the need for further research.

Declaration of Interest

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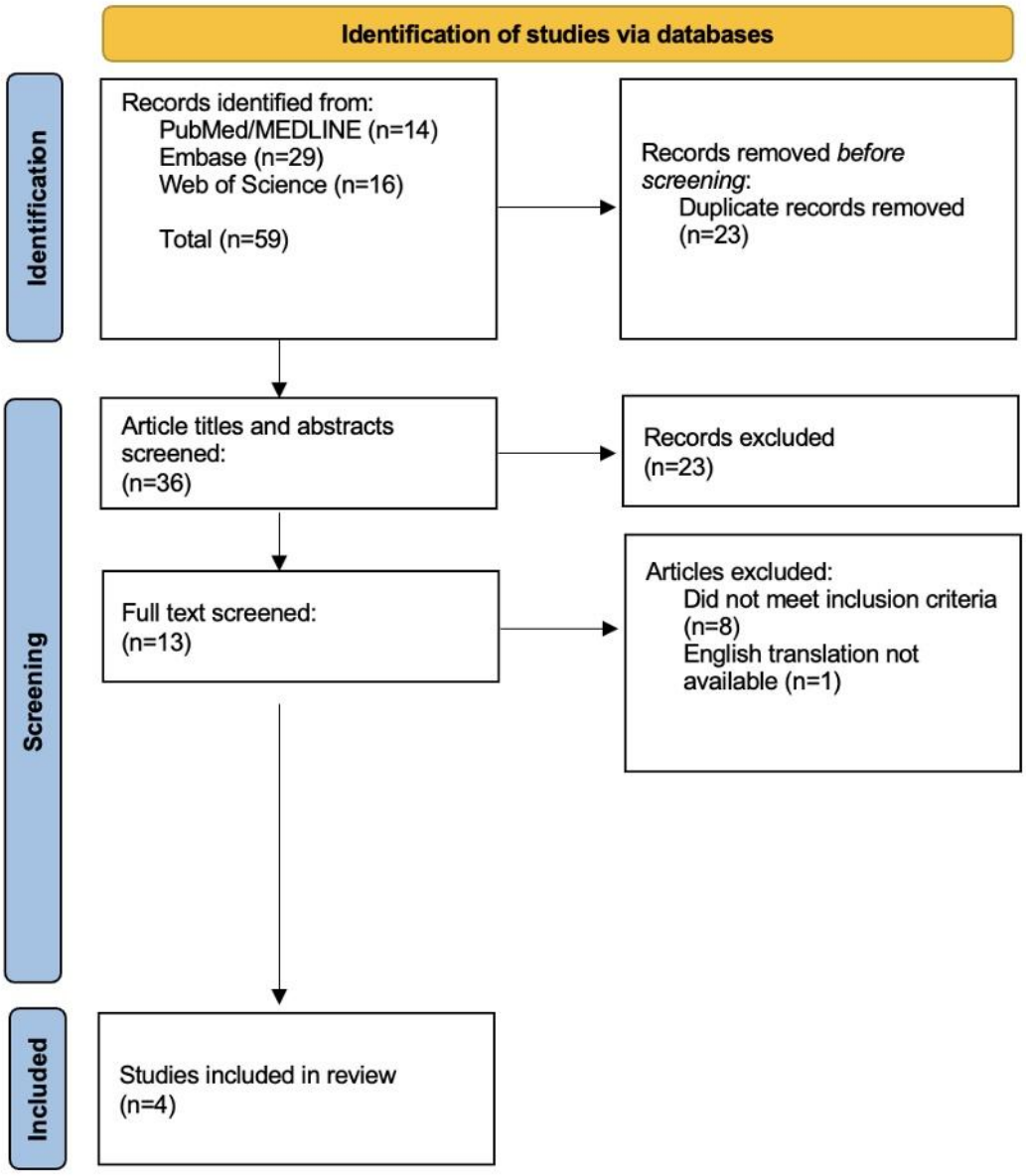
Identification of studies via databases
Identification
Records identified from:
PubMed/MEDLINE (n=14)
Embase (n=29)
Web of Science (n=16)
Total (n=59)
Records removed *before screening*:
Duplicate records removed (n=23)
Screening
Article titles and abstracts screened:
(n=36)
Records excluded
(n=23)
Full text screened:
(n=13)
Articles excluded:
Did not meet inclusion criteria (n=8)
English translation not available (n=1)
Included
Studies included in review
(n=4)

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The measurement tool matters when evaluating outcomes of total knee arthroplasty in patients with posttraumatic OA

Stephanie Waldburger[1], Andres Ladurner[1], David Hamilton[2], Karlmeinrad Giesinger[1]

[1]Kantonsspital St.Gallen, St Gallen, Switzerland. [2]Glasgow Caledonian, Glasgow, United Kingdom

Abstract

Introduction: Posttraumatic osteoarthritis (ptOA) accounts for 10% of total knee arthroplasties (TKA) and is associated with significantly higher complication and revision rates than for primary osteoarthritis (pOA), however, the impact of ptOA on patient outcomes is less clear as authors report inconsistent findings. The purpose of this study is to analyse longitudinal clinical and patient reported outcomes in these patient groups.

Method: A retrospective analysis of prospectively collected data from an institutional database was performed. Patients with a specific clinical history of isolated intraarticular femoral or tibial fractures (ptOA) were identified, and propensity score matched (1:3 ratio) for age, sex and body mass index (BMI) to a comparable cohort receiving TKA for pOA. The outcome at 1 year was assessed using the Western Ontario and McMaster University Osteoarthritis Index (WOMAC), Forgotten Joint Score-12 (FJS-12), EuroQo-5D (EQ-5D), range of motion (ROM) and overall patient satisfaction.

Results: 72 patients with isolated intraarticular ptOA were identified and evaluated against 216 matched pOA patients. This was a young group with mean age 61.0 years, 52% were female. Pre-operative PROMs were equivalent ($p>0.05$). At 1 year, there were no clinically meaningful or statistically significant differences in WOMAC (19.95 vs 15.61; $p= 0.15$) or EQ-5D (0.75 vs 0.80; $p= 0.14$) scores between the two groups. Conversely FJS-12 showed significantly and clinically inferior results in the ptOA group (56.4 vs 71.3; $p= 0.02$), as did measures of pre- and post-operative ROM ($p<0.001$). Overall patient satisfaction was also inferior in the ptOA group (72.4 vs 89.6%; $p=0.001$).

Conclusion: We found no difference in outcome following TKA between patients with primary or posttraumatic OA using tools with restricted measurement ranges (WOMAC or EQ5D), however differences were apparent with more sensitive measurements (FJS-12, knee ROM). This may help explain the differences reported previously.

Declaration of Interest

(b) declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported:I declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research project.

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Design and efficacy of targeted antibodies against biofilm-mediated Staphylococcus aureus infections: a systematic review

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Abstract

Introduction: Staphylococcus aureus is the most frequently encountered pathogen in prosthetic joint infections. Since biofilm formation helps it evade immune clearance via traditional antibiotics, antibodies targeting various antigens involved in biofilm formation are being developed as potential therapeutics. This systematic review describes the design and effectiveness of targeted antibodies against biofilm-mediated S. aureus infection.

Methods: We searched PubMed, Web of Science, Scopus and Embase for clinical and preclinical studies of antibodies against biofilm-mediated infections. Of the 752 records identified, 100/216 studies included focused on S. aureus specifically. Data about the antibody, its antigen, and its suitability for treatment were extracted from each study where available.

Results: Monoclonal and polyclonal immunoglobulin Gs have been shown to be effective at detecting or treating methicillin-resistant and methicillin-sensitive S. aureus infections in vivo, in vitro and ex vivo. Co-administration of antibiotics like vancomycin and daptomycin facilitated biofilm eradication in some instances. However, more recent studies have shown that combining these antibodies with rifampicin or roflumilast to form nanoparticles can also be effective. The antigens targeted include toxins (e.g., alpha toxin), surface adhesins (e.g., clumping factor A), and other cell wall-located proteins (e.g., glucosaminidase, poly-N-acetyl-glucosamine (PNAG), iron-responsive surface determinants, or the manganese transporter SACOL0688). Some concerns that arose from the studies included the epithelial cytotoxicity of the antibodies, their limited effectiveness against surrounding soft tissue infections, and their cross-reactivity with antigens on other bacteria.

Conclusion: Targeted antibodies against biofilm-mediated S. aureus infections are still under active investigation, with few clinical studies to date. Future research will explore strategies used against other biofilm-forming bacteria like Pseudomonas aeruginosa to identify new avenues that could be applied to S. aureus.

Declaration of Interest

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LB1

Technical heterogeneity and reproducibility of proximal fibular osteotomy for knee osteoarthritis: a systematic analysis with exploratory anatomical assessment

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Abstract

Objective: Proximal fibular osteotomy (PFO) is increasingly investigated as a joint-preserving intervention for medial compartment knee osteoarthritis, yet variation in operative technique may limit reproducibility and interpretation of clinical outcomes. This study evaluated the completeness and heterogeneity of PFO technical reporting and contextualised these findings through exploratory cadaveric anatomical assessment.

Design: Operative technique was evaluated across 38 clinical studies identified through a contemporaneous systematic review of PFO (PROSPERO CRD420261386493). Osteotomy level, surgical approach, fibular segment length, common peroneal nerve (CPN) management, neurovascular protection, osteotomy technique and postoperative rehabilitation were synthesised descriptively. Cadaveric dissection of two lower limbs examined the relationship between the CPN and representative osteotomy positions. Findings informed development of a minimum technical reporting framework.

Results: Substantial heterogeneity and incomplete reporting were identified. Osteotomy levels ranged from approximately 4–15 cm distal to the fibular head, although most were within 6–10 cm. Only 2/38 studies (5.3%) explicitly described CPN identification or exposure. Neurovascular protection was explicitly reported in 24/38 (63.2%) and not reported in 6/38 (15.8%). Osteotomy method was explicitly reported in only 4/38 (10.5%), incompletely reported in one (2.6%) and not reported in 33/38 (86.8%). Postoperative rehabilitation was reported in 36/38 studies but varied considerably. Cadaveric assessment demonstrated a greater operative corridor at the more distal assessed position, providing anatomical context for variation in osteotomy localisation and nerve protection.

Conclusions: PFO studies demonstrate substantial technical heterogeneity and incomplete reporting of operative variables relevant to reproducibility and safety. This limits comparison of clinical outcomes and procedure-specific complications across the osteoarthritis literature. Standardised reporting of PFO technique, particularly osteotomy localisation, CPN management and neurovascular protection, is needed to improve reproducibility and strengthen future evaluation of this joint-preserving intervention.

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We hope you have enjoyed the meeting, the scientific programme and your time in Glasgow.

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