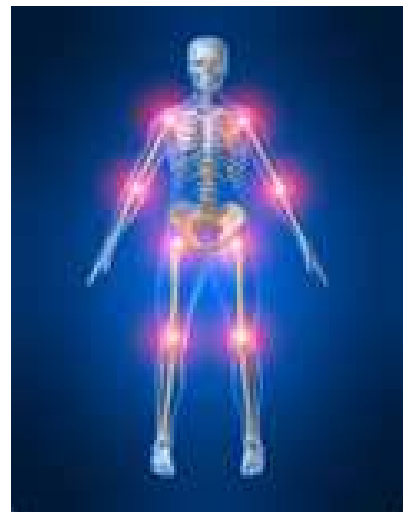


Calgary Orthopaedics 11th Annual Resident Research Day



University of Calgary

Thursday, May 9, 2024
0700 – 1800 hours

Please see Program for specific location of events



Adjudicators:

Dr. Andrew Duckworth, University of Edinburgh, Edinburgh, Scotland

Dr. Claire Temple-Oberle, University of Calgary, Calgary

Dr. Nathan Evaniew, University of Calgary, Calgary

Moderator: Dr. Prism Schneider, University of Calgary, Calgary

Residents:

R5s	R4s	R3s	R2s	R1s
Dr. Annalise Abbott	Dr. Laurel Collings	Dr. Manjot Birk	Dr. Stephanie Gibbon	Dr. Alyssa Federico
Dr. Topher Flanagan	Dr. Erin Davison	Dr. Anna-Lee Policicchio	Dr. Timothy Lasswell	Dr. Mallika Makkar
Dr. Bryan Heard	Dr. Jarrett Moore	Dr. Brodie Ritchie	Dr. Michael Leslie	Dr. Reva Qiu
Dr. Chris Hewison	Dr. Laura Morrison	Dr. Gareth Ryan	Dr. Kaja Matovinovic	Dr. Colin Rey
Dr. Taryn Ludwig	Dr. Julian Rizos	Dr. Ethan Sanders	Dr. Meredith Stadnyk	Dr. Ben Wajda
	Dr. Logan Woods	<i>Brown Highlights: Resident unable to attend 2024 Resident Research Day</i>		

PROGRAM:

Time	Description / Location	Individuals
ACADEMIC SESSION		
0645-0800 hrs	Meet at Hotel Lobby at 0645 hrs Breakfast at Red's Diner – Kensington (286 10 Street NW, Calgary)	Dr. P. Schneider Dr. A. Duckworth
0800-0825 hrs	Travel from Restaurant to Cumming School of Medicine	Dr. P. Schneider Dr. A. Duckworth
0825-0930 hrs	Tour of McCaig Institute for Bone and Joint Health ➤ Injury, Inflammation and Coagulopathy Lab (Dr. P. Schneider) 0830-0850 hrs ➤ Biomechanics Lab (Mr. J. Mang) 0850-0910 hrs ➤ Bone Lab (Dr. S. Boyd) 0910-0930 hrs	Dr. A. Duckworth Dr. P. Schneider Mr. J. Mang Dr. S. Boyd
0930-1105 hrs	Career Development Presentation – Room 1405B, HSC "How to Design, Write and Disseminate your Research" Dr. Duckworth "Evidence-based Orthopaedics: A Team Sport" – Dr. Schneider	All Orthopaedic Residents Dr. A. Duckworth Dr. P. Schneider Dr. C. Temple-Oberle
1105-1115 hrs	Group Photo by Hippocrates Statue	All Orthopaedic Residents Dr. A. Duckworth Dr. P. Schneider Dr. N. Evaniew Dr. C. Temple-Oberle
1115-1215 hrs	Lunch – HRIC Atrium	All Orthopaedic Residents Adjudicators: Dr. A. Duckworth, Evaniew, Temple-Oberle, Schneider Guests: Dr. J. Werle, Dr. N. Desy, Dr. P. Lewkonja, Ms. Z. Abdy, Ms. J. Crawford Sponsor Representatives: Bioventus Ms. P. Haslett // ConMed Ms. S. Paulson & Mr. J. Reid // DePuy Synthes J&J two representatives TBA // MD Management Ms. E. Chiu // Stryker one representative TBA // Tribe Medical Arthrex Mr. K. Jordison
1215-1230 hrs	Short Break and congregate in Theatre 4, HSC	

SCIENTIFIC SESSION – PRESENTATIONS – THEATRE FOUR, HSC

Scientific Session is open to Adjudicators, Orthopaedic Residents, Faculty, Staff, Research Coordinators, the McCaig Institute, ABIHI, and Others			
Types of Resident Presentations (total of twenty-one presentations)			
Full Podium: 6 minutes for presentation/3 minutes Q&A/1 minute transition time (purple shading) Abbreviated Podium: 3 minutes for presentation (maximum of 6 slides)/1 minute transition time/there will be three presented in a row followed by 5 minutes Q&A (orange shading) 3MT Presentations: 3 minutes for presentation (maximum of 1 slide)/1 minutes transition time/there will be three presented in a row followed by 5 minutes Q&A (blue shading)			
1230-1235 hrs	Opening Remarks and Welcome		Dr. Prism Schneider
	Type	Title	Presenter
1235-1245 hrs	Full Abstract	Outcomes and Clinical Significance of Posterior Malleolar Fractures Associated with Diaphyseal Tibial Fracture <i>Presentation Number: 2024-FP1</i>	Dr. Julian Rizos
1245-1255 hrs	Full Abstract	Effects of Teriparatide on Complications and Surgical Outcomes in Patients Undergoing Correction of Adult Spinal Deformity: A retrospective cohort study and cost-effectiveness analysis <i>Presentation Number: 2024-FP2</i>	Dr. Ethan Sanders
1255-1305 hrs	Full Abstract	Inter-rater Reliability of Partially Automated Segmentation of Spinal Radiographs in Adult Spinal Deformity Patients using Keops® <i>Presentation Number: 2024-FP3</i>	Dr. Manjot Birk
1305-1309 hrs	Proposal Abstract	Denosumab Versus Zoledronic Acid in Patients with Metastatic Bone Disease: A systematic review and meta-analysis based on randomized controlled trials <i>Presentation Number: 2024-AP1</i>	Dr. Ben Wajda
1309-1313 hrs	Proposal Abstract	Improving Discharge Education and Rehabilitation Care Pathway Knowledge in Ankle Fracture Patients <i>Presentation Number: 2024-AP2</i>	Dr. Michael Leslie
1313-1317 hrs	Proposal Abstract	Novel Use of Thrombelastography to Assess Hypercoagulable State in Patients with Long Bone Fractures and Concomitant Traumatic Brain Injury: A pilot study <i>Presentation Number: 2024-AP3</i>	Dr. Gareth Ryan
1317-1322 hrs	Q&A for Session One of Abbreviated Presentations		
1322-1342 hrs	Local Internal Adjudicator Presentation: “Resident Research: Oh, the places you’ll go!”		Dr. Nathan Evaniew
1342-1352 hrs	Full Abstract	Dual-Plate Constructs have Improved Biomechanical Properties for Humeral Diaphyseal Fractures Compared to Single-Plate Constructs <i>Presentation Number: 2024-FP4</i>	Dr. Laurel Collings
1352-1402 hrs	Full Abstract	Clinical Outcomes of Distal Biceps Tendon Injuries Vary by Treatment Strategy <i>Presentation Number: 2024-FP5</i>	Dr. Laura Morrison
1402-1412 hrs	Full Abstract	Assessment of Radiographic Healing Reliability and Accuracy in Distal Radius Fractures <i>Presentation Number: 2024-FP6</i>	Dr. Erin Davison
1412-1422 hrs	Full Abstract	Volar Cortical Displacement Reliably Predicts Delayed Displacement of Distal Radius Fractures <i>Presentation Number: 2024-FP7</i>	Calgary Orthopaedic Resident Research Group (CORRG)
1422-1426 hrs	Proposal Abstract	Feasibility of Navigation-assisted Arthroscopic Knee Ligament Reconstruction <i>Presentation Number: 2024-AP4</i>	Dr. Tim Lasswell
1426-1430 hrs	Proposal Abstract	Evaluation of Scapholunate Ligament Injury on Weight Bearing CT <i>Presentation Number: 2024-AP5</i>	Dr. Brodie Ritchie

1430-1434 hrs	Proposal Abstract	Optimal Construct for Fixation of Femoral Neck Fractures: A biomechanical analysis <i>Presentation Number: 2024-AP6</i>	Dr. Anna-Lee Policicchio
1434-1439 hrs	Q&A for Session Two of Abbreviated Podium Presentations		
1439-1510 hrs	Break		
1510-1515 hrs	Return to Theatre 4, HSC		
1515-1540 hrs	Local External Adjudicator Presentation: "Minimizing Morbidity in Oncologic Reconstruction"		Dr. Claire Temple-Oberle
1540-1544 hrs	Proposal Abstract	Incidence and Risk Factors for Arthrofibrosis After Primary ACL Reconstructive Surgery: A systematic review <i>3MT Presentation Number: 2024-3MT1</i>	Drs. Reva Qiu & Alyssa Federico
1544-1548 hrs	Proposal Abstract	Impact of Social Determinants of Health on Access to Primary Total Hip and Knee Arthroplasty in Public Healthcare Settings: A scoping review <i>3MT Presentation Number: 2024-3MT2</i>	Dr. Mallika Makkar
1548-1552 hrs	Proposal Abstract	Use of High-Resolution Peripheral Quantitative Computed Tomography to Determine the Effect of Early Weightbearing on Fracture Union in Ankle Fractures <i>3MT Presentation Number: 2024-3MT3</i>	Drs. Alyssa Federico & Topher Flanagan
1552-1556 hrs	Proposal Abstract	Evaluation of the Novel Volar Cortical Displacement Parameter as a Radiographic Predictor of Delayed Distal Radius Fracture Displacement <i>3MT Presentation Number: 2024-3MT4</i>	Dr. Kaja Matovinovic
1556-1602 hrs	Q&A for Session One of 3MT Presentations		
1602-1612 hrs	Full Abstract	Timely Hip Fracture Surgery in Adult Hip Fracture Patients Receiving Pre-injury Anticoagulation: A prospective study <i>Presentation Number: 2024-FP8</i>	Dr. Stephanie Gibbon
1612-1622 hrs	Full Abstract	Lower Implant Removal Rates Occur Following Posterolateral Antiglides Fixation for Distal Fibula Fractures <i>Presentation Number: 2024-FP9</i>	Dr. Logan Woods
1622-1632 hrs	Full Abstract	Robotic Assessment of Post-call Sensorimotor and Cognitive Function in Orthopaedic Surgery Residents <i>Presentation Number: 2024-FP10</i>	Dr. Laura Morrison
1632-1720 hrs	Keynote Address: "Olecranon Fractures – what I have learnt"		Dr. Andrew Duckworth
1720-1725 hrs	Closing Remarks		Dr. Prism Schneider
1725-1735 hrs	Deliberation Time for Judges		
1735-1800 hrs	Travel to Dinner Location		Dr. P. Schneider to drive Dr. A. Duckworth
1800 hrs	Dinner (by invitation only) at Model Milk in Private Room: Model Citizen)		

Biographies of Adjudicators and Moderator

Guest Adjudicator: Dr. Andrew Duckworth



Dr. Andrew Duckworth is a Senior Clinical Lecturer in the Usher Institute at the University of Edinburgh and an Honorary Consultant Orthopaedic Trauma Surgeon in Edinburgh Orthopaedics at the Royal Infirmary of Edinburgh. Following completion of his training in Edinburgh, he was an Upper Limb Fellow at the Wrightington Upper Limb Unit. His clinical and research interests are in trauma and upper limb surgery, with a focus on injuries around the elbow, wrist and hand. His current research includes multi-centre clinical trials in orthopaedic trauma, large data studies and the efficacy of patient reported outcome measures. He is Co-Cl, co-app and PI on NIHR funded clinical trials. He is an Editorial Board Member for the Bone and Joint Journal (BJJ), Bone and Joint Research (BJR), Bone & Joint³⁶⁰ and the Journal of Orthopaedic Trauma (JOT). He is also on the Research

Committees of the Orthopaedic Trauma Association (OTA) and the Orthopaedic Trauma Society (OTS). He is a co-director of the world-renowned Edinburgh International Trauma Symposium and is a member of the Edinburgh Sports Medicine Research Network and the UKCCIIS IOC Research Centre of Excellence.

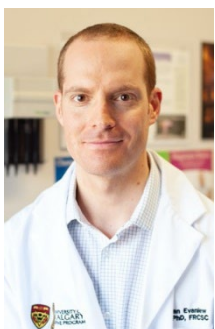
Local External Adjudicator: Dr. Claire Temple-Oberle



Dr. Temple-Oberle is a Professor in the Cumming School of Medicine at the University of Calgary in the Departments of Oncology and Surgery, with a special interest in reconstructive plastic surgery. She completed her MD at Queen's University, a plastic surgery residency at the University of Western Ontario, and then undertook fellowships at MD Anderson Cancer Center in reconstructive microsurgery and surgical oncology at the Tom Baker Cancer Centre. Dr. Temple-Oberle worked in the Departments of Surgery and Oncology at University of Western Ontario from 2003 to 2011. During this time, she completed an MSc in Epidemiology at the Harvard School of Public Health. She is currently pursuing a Masters of Medical Education at the University of Dundee. Dr. Temple-Oberle's research primarily focuses on two areas: breast reconstruction and intransit melanoma.

In the area of breast reconstruction, she has developed a validated quality of life instrument, the BRECON-31, led an international team to develop a globally recognized Enhanced Recovery After Surgery (ERAS) protocol for breast reconstruction. She has lead or co-lead a number of studies and clinical trials surrounding new techniques in breast reconstruction, epidemiology of breast reconstruction rates in Alberta, and decision support for patients contemplating breast reconstruction. She has also led efforts to evaluate the efficacy of Interleukin-2 and has worked to have the therapy approved for intransit melanoma patients. Her research also extends to microsurgical skills training for plastic surgery residents. She developed the UWOMSA (University of Western Ontario Microsurgical Skills Acquisition/Assessment) instrument and currently holds the Royal College Maudsley Fellowship for Studies in Medical Education wherein she is developing teaching tools to enhance plastic surgeon residency competency in microsurgical skills.

Local Internal Adjudicator: Dr. Nathan Evaniew



Dr. Nathan Evaniew is an orthopaedic spine surgeon at Foothills Medical Centre in Calgary. He completed medical school at the University Calgary, an orthopaedic surgery residency and PhD in Clinical Epidemiology and Biostatistics at McMaster University, and combined orthopaedic and neurosurgical spine surgery fellowships at the University of British Columbia and the University of Calgary. His research focuses on improving the lives of patients with spinal disorders via the paradigm of evidence-based medicine, and he is a co-principal investigator of the ongoing CSORN Degenerative Cervical Myelopathy observational study.

Moderator: Dr. Prism Schneider



Dr. Prism Schneider is an Associate Professor of Orthopaedic Surgery in the Departments of Surgery and Community Health Sciences, at the University of Calgary. She also holds the positions of Orthopaedic Trauma Research Lead and the Faculty, Resident and Fellow Research Director for Orthopaedic Surgery. She obtained her MD from the University of Calgary and has completed post-graduate training including a PhD in Biomechanics and two Orthopaedic Trauma Fellowships at the University of Texas and McGill University. Dr. Schneider's research interests involve understanding the cellular and systemic inflammatory response to injury, including trauma-induced coagulopathy and post-traumatic joint contractures, clinical trials for optimizing surgical outcomes, and using advanced imaging to study the micro-architecture of fracture healing. She

also has a particular interest in identifying and assisting patients who are injured due to violence in the home. Dr. Schneider has completed several multi-centre randomized controlled trials in collaboration with the Canadian Orthopaedic Trauma Society, in order to define surgical indications following injury and to determine the optimal surgical techniques to help improve patient outcomes. Dr. Schneider's trauma-induced coagulopathy research program aims to use a precision medicine approach to prevention of venous thromboembolism and is funded by the Orthopaedic Research and Education Foundation, the Canadian Institutes for Health Research, and the Canadian Foundation for Innovation.

Abstract Type: Full

Research Pillar: Clinical Research

Title: Outcomes and Clinical Significance of Posterior Malleolar Fractures Associated with Diaphyseal Tibial Fracture

Authors: Julian Rizos, John Kendall and Prism Schneider

Background: Recent studies demonstrate high incidence of occult posterior malleolar fractures (PMFs) associated with tibial shaft fractures (TSFs) that cannot be identified using plain radiographs. Computed tomography (CT) scans are effective in identifying occult PMFs, but CT scans expose patients to greater radiation, are expensive, may delay surgery, and are not readily available in all resource settings. Pre-operative PMF identification permits “malleolus-first” fixation to mitigate risk of articular displacement with tibial nail insertion, however, this surgical sequence increases operative time and introduces risk of neurovascular injury. Therefore, the aim of this study was to assess PMF morphology, treatment and outcomes when associated with TSFs to evaluate clinical significance of these concomitant injuries.

Methods: This is a multi-centre, retrospective, observational cohort study based on the Alberta Health Services Data Integration, Measurement and Reporting (DIMR) provincial database. Skeletally-mature patients with an acute TSF and associated PMF on plain radiographs or cross-sectional imaging were included. Fracture-, injury- and patient-factors were assessed. Differences and outcomes of different PMF treatment strategies were evaluated using descriptive statistics when associated with a TSF. All available post-operative radiographs were studied unless PMF union was confirmed on serial films prior to discharge from the surgeons’ practice.

Results: A total of 618 patients with TSFs were screened, with 20% (n=124) demonstrating an associated PMF and being included in this analysis (mean age = 46 years, [SD = 14.5 years]; 59% male). The most common location of TSF was distal third (96%) and the most common TSF morphology was spiral (69%). Axial imaging revealed that posterolateral oblique was the most common PMF morphology (63%). Low energy trauma, defined as a fall from less than three meters and at less than 30 kilometers per hour comprised 86% of the studied fractures. A total of 93% of all PMFs united by final follow-up, with an average union time of 3 months (SD = 2.3 months).

Of the 124 TSF cases with concurrent PMFs, 33 (27%) underwent posterior “malleolus-first” fixation prior to tibial nailing, with anterior to posterior screws being the most common surgical technique used. In this group, the PMF size averaged 39% of the articular surface, was displaced on average 1.1mm (SD = 0.8mm) at the time of injury, and post-operative displacement decreased to 0.3mm on average (SD = 0.4mm). Conversely, 82 (66%) of the 124 cases of TSFs with associated PMFs that were not treated with “malleolus-first” fixation prior to tibial nailing on average comprised 28% of the articular surface, were displaced 0.7mm (SD = 0.6mm) at the time of injury, which increased to 1.0mm (SD = 0.62mm) postoperatively. Both “malleolus-first” and no fixation groups demonstrated high union rates of 92% and 93%, respectively. The remaining 9/124 (7%) of TSFs with concurrent PMFs were treated with all plate fixation (no tibial nail) or the limb was amputated.

Discussion: This study demonstrates an average increase in intraarticular displacement of 0.3mm in the absence of preliminary PMF fixation when a tibial nail is used to treat a TSF. Conversely, posterior “malleolus-first” fixation decreased the articular displacement on average by 0.8mm. Despite this disparity union rates were comparably high in both groups.

Conclusion: Orthopaedic surgeons may use this data to inform decision making when weighing the risks and benefits of pre-operative investigations and intra-operative surgical interventions for PMF fixation.

Acknowledgments: Foothills Orthopaedic Research Team, including Jessica Duong, Leah Kennedy, Stephanie Yee, and The Machine Learning Consortium

COREF Funded: Yes

Abstract Type: Full

Research Pillar: Clinical Research

Title: Effects of Teriparatide on Complications and Surgical Outcomes in Patients Undergoing Correction of Adult Spinal Deformity: A Retrospective Cohort Study and Cost–Effectiveness Analysis

Authors: Ethan Sanders, Amit Parekh, Manjot Birk and Fred Nicholls

Background: Mechanical complications and symptomatic pseudarthrosis are common sequelae in the surgical management of adult spinal deformity (ASD). There is evidence that for ASD patients undergoing surgery, teriparatide may reduce mechanical complication rates and improve fusion rates. The aim of this study is to 1) examine the effects of teriparatide on complication rates in surgical correction of ASD; 2) Assess cost-effectiveness of teriparatide in ASD.

Methods: Retrospective cohort study with data collected from the local CSORN database and chart review with institutional REB approval of ASD cases from 2016-2022. A total of 30 patients, with a minimum of 3 months of treatment with teriparatide were identified. These patients were matched against controls using 15 covariates, resulting in 60 total patients. No significant differences were identified. The mean age of the cohort was 67 years, with more female patients (n=46). Most patients had instrumentation to the pelvis. Patients were followed for a minimum of 12 months (range 12-70). Data collected on these patients included: medical history, surgical data, and bone mineral density (BMD) testing (DEXA and CT Hounsfield Units). Outcome measures included mechanical complications, as well as symptomatic pseudarthrosis. Cost analysis was completed by compared absolute risk reduction (ARR) and number needed to treat (NNT) to prevent one revision, with the cost of teriparatide. Statistical analysis was performed using MatLab.

Results: Pre-Op BMD was lower in patients treated with teriparatide, both in HU and DEXA across all sites of measurement. Post-Op Hip DEXA scores in matched controls were significantly less compared to pre-op (-0.95 vs -0.65, p=0.008). When mechanical complications were combined with symptomatic pseudarthrosis patients treated with teriparatide had significantly fewer complications (11 vs 19, p=0.038). This correlates to 66.3 % of patients in the control group had significant complication, compared to 36.7% in the treatment group. Number of patients requiring revision surgery was significantly less in the treatment group (7 vs 15, p=0.032). When considering the cause of revision, the combined number of revisions for mechanical complications and symptomatic pseudarthrosis was significantly less in those treated with teriparatide (5 (16.7%) vs 15 (50.0%), p=0.006). To control for confounders, adjuncts for prevention of mechanical complications (hooks, vertebroplasty, ligamentoplasty) were recorded and found to be similar between groups. Patients treated with teriparatide underwent treatment for an average of 7.1+/-5.0 months pre-operatively, and 4.5 +/- 4.9 months post-operatively. There was no statistically significant relationship between duration or timing of treatment and significant complication. A cost-benefit analysis was performed, this revealed an ARR of 33.3%, and NNT of 3 to prevent revision surgery. Treatment with teriparatide for 18 months has an average cost of \$14,400 CAD, while revision surgery costs 75, 219-\$161,437 CAD.

Discussion: Our data on bone mineral density, although limited by sample size, supports the growing body of evidence that suggests teriparatide use for ASD may benefit patients and healthcare systems. The relative decrease in bone mineral density that may occur in ASD patients with normal bone quality, combined with the growing but limited evidence of teriparatide as a benefit towards fusion rates, would suggest that teriparatide may benefit patients with both healthy and poor bone quality. Teriparatide is Health Canada approved for the treatment of osteoporosis for a period of 18 months but remains off label for use in ASD.

Conclusion: We observed that patients treated with teriparatide had a significantly reduced combined rate of mechanical complications and symptomatic pseudarthrosis as well as a significantly reduced risk of requiring revision surgery. A simplified cost analysis suggests that teriparatide use in this setting is both cost-effective and cost-saving.

Acknowledgements: None

COREF Funded: No

Abstract Type: Full

Research Pillar: Clinical Research

Title: Inter-rater Reliability of Partially Automated Segmentation of Spinal Radiographs in Adult Spinal Deformity Patients Using Keops®

Authors: Manjot Birk, Rémi Pelletier-Roy, Taryn Ludwig, Nathan Evaniew, Peter Lewkonja, Kenneth C. Thomas, Ganesh Swamy, Bradley Jacobs and Fred Nicholls

Background: The measurement of spinal and pelvic alignment parameters in the frontal and sagittal planes is critical in assessing and treating adult spinal deformity (ASD) patients. Several studies have demonstrated excellent intra- and inter-rater reliability of traditional manual and digital measurements, however these remain cumbersome, time consuming, difficult to verify and often need to be repeated in ongoing studies.¹⁻³ This study seeks to determine the inter-rater reliability of partially automated segmentation of sagittal and coronal spinal radiographs of ASD patients using Keops® software.

Methods: Five patients with ASD were specifically selected from our local database to represent instrumented and non-instrumented ASD patients with sagittal only and coronal and sagittal deformity. Preoperative and postoperative full length sagittal and coronal spinal radiographs were selected to represent clinically relevant scenarios. Five fellowship-trained spine surgeons, one spine fellow and one orthopaedic resident, blinded to the patient data, performed segmentation on each image using Keops® software. Each rater was instructed to segment using the software from the hips to the most cranial spinal level possible. This data was analyzed using SPSS (29.0) and reliability between raters was determined using intraclass correlation coefficients (ICC) with 95% confidence intervals. ICC of <0.70, 0.70-0.79, 0.80-89, and 0.9-0.99 were considered poor, fair, good, and excellent reliability, respectively.

Results:

Parameter	ICC - all raters	CI Lower Bound	CI Upper Bound	Reliability
Pelvic Obliquity	0.992	0.981	0.998	Excellent
Main Curvature	0.955	0.889	0.988	Excellent
Thoracic Kyphosis	0.964	0.909	0.991	Excellent
TPA	0.994	0.985	0.998	Excellent
Lumbar Lordosis	0.991	0.977	0.998	Excellent
Sacral Slope	0.986	0.966	0.996	Excellent
Pelvic Tilt	0.994	0.985	0.998	Excellent
Pelvic Incidence	0.986	0.966	0.996	Excellent
Spinosacral Angle	0.990	0.976	0.997	Excellent
C2-C7 Lordosis	0.954	0.851	0.995	Excellent

Table 1: Results of intraclass correlation coefficient for each spinal parameter

Discussion and Conclusion: Our results confirm partially automated segmentation of ASD patients using Keops® software maintains excellent inter-rater reliability for key spinal parameters as per table 1. We conclude that Keops® demonstrated excellent inter-rater reliability for frontal and sagittal spinal parameters in ASD patients. Measurement and segmentation involving the cervical spine remains challenging above C2 on sagittal radiographs and C7 on frontal radiographs.

Acknowledgements: None

COREF Funded: No

Abstract Type: Proposal

Research Pillar: Basic Science

Title: Denosumab Versus Zoledronic Acid in Patients with Metastatic Bone Disease: A Systematic Review and Meta-analysis Based on Randomized Controlled Trials

Authors: Ben Wajda, Leah Ferrie, Annalise Abbott, Michael Monument and Joseph Kendal

Background: Metastatic bone disease (MBD) presents significant challenges in patient management, often leading to skeletal-related events (SREs), compromised quality of life, and heightened pain experiences. Denosumab and zoledronic acid are two bone modifying agents commonly employed to mitigate the sequelae of MBD, yet their comparative efficacy across multiple outcomes has yet to be reported in a single comprehensive analysis. This systematic review and meta-analysis aims to evaluate the efficacy and safety profiles of denosumab versus zoledronic acid in patients with MBD, focusing not only on SREs and adverse events, but also on patient pain outcomes, analgesic usage, and quality of life.

Methods: A literature search using MEDLINE and EMBASE identified relevant randomized controlled trials (RCTs) comparing denosumab with zoledronic acid in patients with MBD up to February 15th, 2024. Two independent reviewers assessed studies for inclusion, according to predetermined criteria and the relevant data was extracted. Primary outcomes of interest were SRE incidence, overall survival, and time to first on-study SRE. Secondary outcomes included pain, quality of life, analgesia usage, and adverse events. A meta-analysis will be performed using random-effects models to pool effect sizes across studies.

Results: A total of 7 RCTs met the inclusion criteria with a total of 7425 unique patients. Results are pending as data extraction is currently being undertaken.

Discussion: This meta-analysis seeks to provide robust and comprehensive evidence comparing denosumab with zoledronic acid in reducing SREs, improving pain outcomes, and enhancing quality of life in patients with MBD. Our aim is that these findings will enhance providers' understanding of the utility of these agents in the MBD patient population, thereby aiding in guiding prescribing decisions. The anticipated results of our meta-analysis comparing denosumab with zoledronic acid in patients with MBD has the potential to contribute to future work in generating comprehensive evidence-based standardized treatment protocols for patients suffering from MBD in Alberta.

Conclusion: This meta-analysis seeks to provide robust and comprehensive evidence in the comparison of denosumab versus zoledronic acid in the treatment of MBD. Outcomes evaluated were: SRE incidence, overall survival, time to first on-study SRE, pain outcomes, quality of life, analgesia usage, and adverse events in patients with MBD. With our findings we hope to underscore the clinical significance of these bone modifying agents and contribute towards the development of future standardized treatment protocols for Albertans suffering from MBD.

Acknowledgements: N/A

COREF Funded: No

Abstract Type: Proposal

Research Pillar: Clinical Research

Title: Improving Discharge Education and Rehabilitation Care Pathway Knowledge in Ankle Fracture Patients

Authors: Michael Leslie, Prism Schneider and Andrew Dodd

Background: The amount of information that a patient receives in the perioperative period following an injury can be overwhelming. Patients are often unable to recall details of their diagnosis, treatments, and procedures. Additionally, there can be limited retention of critical information regarding their injury or post-operative care pathway, including rehabilitation and follow-up instructions. This lack of information retention can lead to lower engagement levels and adherence to post-operative instructions, which can negatively impact patient outcomes and can extend the time required to return to pre-operative function, daily activities, and work. Furthermore, poor comprehension can lead to longer follow-up appointments to repeat the same rehabilitation principles and management pathways, taking valuable time away the specific needs of the patient. This highlights the need for improved patient education for injured patients undergoing surgery in the acute setting.

This project aims to address this care gap by developing, implementing, and evaluating a novel educational video for patients with ankle fractures, who are being discharged from hospital post-operatively. Ankle fractures were chosen due to their abundance in orthopaedic trauma and the importance of adherence to post-operative instructions, such as weightbearing and driving status. We hypothesize that this video will improve patient knowledge, satisfaction, and adherence to rehabilitation pathways, thereby enhancing functional outcomes and reducing time away from activities and work.

Methods: A single-centre pilot randomized control trial of adult patients with an acute ankle fracture requiring assessment by the orthopaedic trauma service at the Foothills Medical Centre will be performed. The study will enroll 60 participants with acute ankle fractures, who will be assigned to one of three study groups (Figure 1). The video will include anatomic information specific to their injury, information on fractures and bone healing, treatment goals, and a detailed care pathway for rehabilitation after ankle fractures.

Data collection will occur at standardized follow-up timepoints until six weeks post-injury using a custom online database. The control group will complete the knowledge and satisfaction surveys after receiving the current standard discharge information. This information will be used to compare patient satisfaction to those that have received the educational video at discharge and follow-up. We will also distribute functional questionnaires such as Measure Pain, Visual Analogue Scale, Foot and Ankle Outcome Score (FAOS), and 12-Item Short Form Survey (SF-12).

The primary outcome measure will be patient satisfaction through our custom satisfaction survey. Results of these surveys will be analyzed using independent samples t-tests for comparison between the three study groups at various time points.

Descriptive statistics will be used to compare demographic data between groups and to compile mean response levels on the post-discharge survey. Secondly, we will assess functional outcomes and time taken to return to work or activities between groups.

Results: N/A

Discussion: N/A

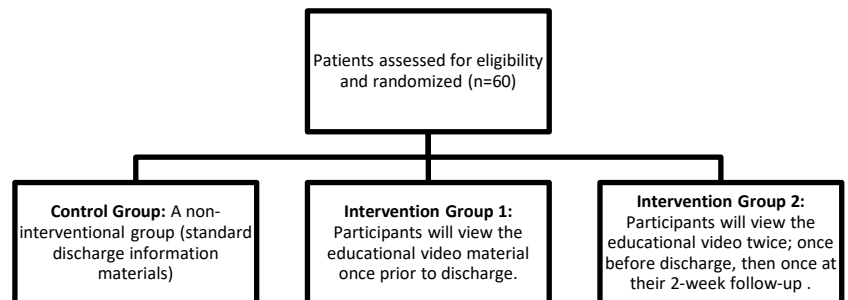


Figure 1: Study groups for randomized control trial (20 patients per group)

Conclusion: Many patients struggle to recall injury, treatment, or rehabilitation details post-hospitalization, resulting in extended follow-up appointments and less personalized care. We believe that improved patient education and access to educational resources will improve patient comprehension of their injuries and expected post-operative care pathways. By creating a patient education video, we hope to enhance patient understanding of their injury and rehabilitation, increase satisfaction of care, and reduce patient time away from activities and work.

Acknowledgments: Workers' Compensation Board of Alberta, Foothills Orthopaedic Trauma Research Team

COREF Funded: No

Abstract Type: Proposal

Research Pillar: Clinical Research

Title: Novel Use of Thrombelastography to Assess Hypercoagulable State in Patients with Long Bone Fractures and Concomitant Traumatic Brain Injury: A Pilot Study

Authors: Gareth Ryan, Andrew Dodd, Paul Duffy, Herman Johal, Rob Korley and Prism Schneider

Background: Approximately 20-30% of patients with femur or tibia fractures suffer concomitant traumatic brain injuries (TBI). In the setting of polytrauma, patients with TBI have an elevated risk for venous thromboembolism (VTE), with an odds ratio of 2.6. Early pharmacologic thromboprophylaxis is often contraindicated in TBI patients given the risk of intracranial bleeding, thereby further increasing VTE risk. Inferior vena cava (IVC) filter insertion is controversial, but sometimes the only option. Additionally, there are no guidelines surrounding thromboprophylaxis in patients with TBI and fractures. The aim of this study is to define the duration of hypercoagulability using serial thrombelastography (TEG) in this complex population.

Methods: This will be a single-centre, prospective cohort of 30 patients with fractures and concomitant TBI, and 30 patients with isolated fractures. Patients aged 18-65 years with surgically managed diaphyseal femur or tibia fractures will be eligible for participation. Patients with severe open fractures, previous VTE, known coagulopathy, active pregnancy, pre-injury therapeutic anticoagulation, and chronic steroid use will be excluded. Concomitant TBI will be defined as head trauma with a Glasgow Coma Score (GCS) <12 on presentation to the emergency department and acute findings on CT head. Age, sex, body mass index (BMI), past medical history, medications, alcohol/substance use, socioeconomic status, mechanism of injury, Injury Severity Score (ISS), and fracture characteristics will be recorded. Timing and type of thromboprophylaxis will be at the discretion of the attending service, but will be recorded.

Blood samples will be collected pre-operatively, then at 24, 48, and 72 hours postoperatively and at two, four, and six weeks postoperatively. Samples will be analyzed using a TEG 6s Hemostasis Analyzer (Haemonetics Corp; Boston, MA). Hypercoagulability will be defined as maximal amplitude (MA) ≥ 65 mm. Screening lower extremity Doppler ultrasound will be performed at 72 hours and two weeks postoperatively to examine for clinically significant proximal VTE, as participants may be unable to convey their symptoms. Additional CT and Doppler imaging will be performed to investigate symptomatic VTE.

Coagulation profiles will be compared between TBI and non-TBI groups at each timepoint. Our primary outcome measure will be duration of hypercoagulability (MA ≥ 65 mm), which has been shown to correspond with clinical VTE risk. Our secondary outcome measures will include incidence of VTE, insertion of IVC filters, thromboprophylaxis prescribed, and bleeding events, as defined by the International Society on Thrombosis and Hemostasis (ISTH) criteria.

Results: N/A

Discussion: Patients with long bone fractures and concomitant TBI present a unique challenge regarding VTE prevention. This will be the first study to objectively quantify the duration of hypercoagulability in this population. Our novel results will address a critical care gap and help inform clinicians when balancing the risk of VTE with the risk of recurrent bleeding. This novel data will help guide decisions around initiation and duration of thromboprophylaxis, as well as use of IVC filters, in patients with TBI and femur or tibia fractures.

Conclusion: Determining the severity and duration of hypercoagulability in patients with TBI and fractures will inform decisions surrounding thromboprophylaxis and perioperative management of this complex population.

Acknowledgements: Foothills Orthopaedic Trauma Research Team, Calgary Surgical Research Development Fund, Calgary Orthopaedic Resident Education Fund, Canadian Venous Thromboembolism Research Network, Canadian Institute of Health Research, Orthopaedic Trauma Association.

COREF Funded: Yes

Abstract Type: Full

Research Pillar: Basic Science

Title: Dual-Plate Constructs Have Improved Biomechanical Properties for Humeral Diaphyseal Fractures Compared to Single-Plate Constructs

Authors: Laurel Collings, Helena Greene, Paul Sharplin, Christoff-Johan Lee, Ifaz Haider and Prism Schneider

Background: Single-plate constructs are traditionally used for mid-diaphyseal humerus fracture fixation. Dual-plate constructs are an alternative fixation method with advantages including less extensile dissection, provisional fixation for rotationally unstable fractures, and increased screw density. This study aimed to compare biomechanical properties for dual small and mini-fragment orthogonal plating with single small-fragment plating using a cadaveric model.

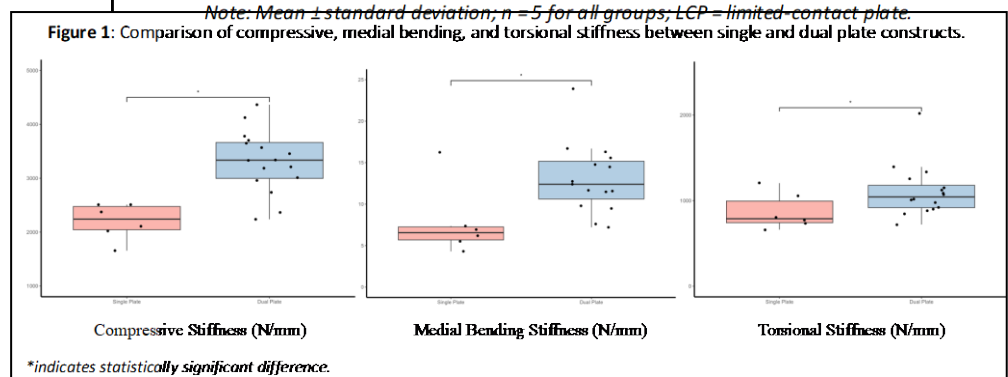
Methods: Each specimen was randomized to one of four groups, stratified by computed tomography-based bone mineral content (BMC). We compared four plating configurations: Group A, fixation with a single anterolateral 3.5-mm Locking Compression Plate (LCP), and three different dual-plate constructs (Group B: 3.5-mm LCP and 2.7-mm LCP; Group C: 3.5-mm LCP and one-third tubular plate; and Group D: dual 2.7-mm LCP).

A transverse osteotomy model with a 5-mm gap was created and specimens were plated with eight cortices of fixation above and below the osteotomy. Axial, bending, and torsional stiffness were determined through non-destructive testing, followed by torsional load-to-failure testing (MTS 858 Bionix). One-way ANOVA was used to evaluate differences between stiffness and failure testing of each construct.

Results: A total of 20 cadaveric specimens were tested. No significant differences were seen between the different groups for age (mean=62.6 years [SD=14.5]; p=0.19), sex (64% female; p=0.89), or BMC (mean=74.3g [SD=20.2]; p=0.99; Table 1).

Construct	Age (y)	BMC (g)
Group A - 3.5mm LCP	66 ± 15.84	75.64 ± 24.75
Group B - 3.5mm LCP + 2.7mm LCP	72.6 ± 14.77	74.57 ± 22.21
Group C - 3.5mm LCP + 1/3 tubular	52.2 ± 13.68	73.23 ± 24.18
Group D - 2.7mm LCP + 2.7mm LCP	60.6 ± 8.29	73.79 ± 21.74

Dual-plate constructs demonstrated higher stiffness in axial compression, medial bending, and torsional testing compared to single-plate constructs (p<0.01, p=0.03, and p=0.04, respectively). There was no significant difference between posterior bending stiffness and torsional load-to-failure between single and dual-plate constructs (p=0.63 and p=0.83, respectively).



When pairwise group comparisons were made, there was no statistically significant difference in medial or posterior bending, axial compression, torsional stiffness, or torsional load-to-failure between all dual-plating groups (p=0.29-0.92; Figure 1).

Discussion: These novel data support the hypothesis that dual plate constructs have higher stiffness compared to single plate constructs for humeral diaphyseal fracture fixation. Additionally, our results demonstrate no significant difference between the dual plate constructs for each testing arm.

Conclusion: This study is the first to examine the biomechanical differences of multiple single and dual plate constructs for fixation of mid-diaphyseal humerus fractures using cadaveric models. Given increasing evidence to support early functional improvements with operative intervention for mid-diaphyseal humerus fractures, the results of this study provide further biomechanical evidence to guide operative decision-making and may be used to inform future clinical studies.

Acknowledgements: Dr. Brent Edwards from the Biomechanics Lab in the McCaig Institute for Bone and Joint Health, the Foothills Medical Centre Orthopaedic Trauma Research Team, especially Dr. Jessica Duong.

COREF Funded: Yes

Abstract Type: Full

Research Pillar: Clinical Research

Title: Clinical Outcomes of Distal Biceps Tendon Injuries Vary by Treatment Strategy

Authors: Laura Morrison, Justen Saini, Alex Munn, Tomasz Bugajski, Chloe Elliot, Bayan Ghalimah, Adina Tarcea, Koren Roach and Neil White

Background: Missed distal biceps injuries can be difficult to treat. Depending on time from injury to diagnosis and the degree of tendon retraction, a primary or direct repair (DR) technique may not be possible. If the tendon is retracted or the tissue quality is poor, an allograft reconstruction (AR) may be required. High flexion angle (HFA) repairs are also gaining popularity, whereby the elbow is flexed greater than 60 degrees to achieve anatomic placement using the native tendon. Alternatively, some patients may choose to proceed with non-surgical (NS) treatment, despite a full thickness tendon rupture. The expected clinical outcomes such as strength and endurance of the affectfor each treatment strategy are not well known. We hypothesized that participants with distal biceps tendon ruptures managed with surgical treatment (ST) would have increased flexion/supination strength and endurance compared to those treated non-surgically. Amongst participants treated surgically, we hypothesized that those undergoing direct repair (DR) would have similar flexion/supination strength and endurance to those treated with allograft reconstruction (AR) and high flexion angle repair (HFR).

Methods: A retrospective chart review from a single center between 2012-2022 was performed to identify individuals who suffered a distal biceps tendon rupture. A total of 437 individuals were identified, of which 363 were treated surgically and 74 were treated non-surgically. Currently, 31 participants (age: 52.32 ± 9.64 years; body mass index: 30.59 ± 3.75 kg/m²; time since injury: 1642 ± 867 days) with a previous distal biceps tendon rupture (DR: n = 6; AR: n = 5, HFR: n = 9, NS: n = 11) have been recruited for this ongoing study. Peak torque, total work, and work fatigue were measured to assess biceps strength and endurance. Participants performed 50 repetitions of bilateral forearm supination/pronation followed by 50 repetitions of bilateral elbow flexion/extension on a Biodex dynamometer. Due to small sample sizes at this time, all surgically treated participants (DR, AR, HFR) were combined into one group and compared to the NS group. For each movement, a repeated measure General Linear Model ($\alpha = 0.05$) was used to assess within-participant differences between their control and affected limbs and between-participant differences in the ST and NS groups. At the time of presentation, we anticipate having data for 15 participants in each cohort (DR, AR, HFR and NS).

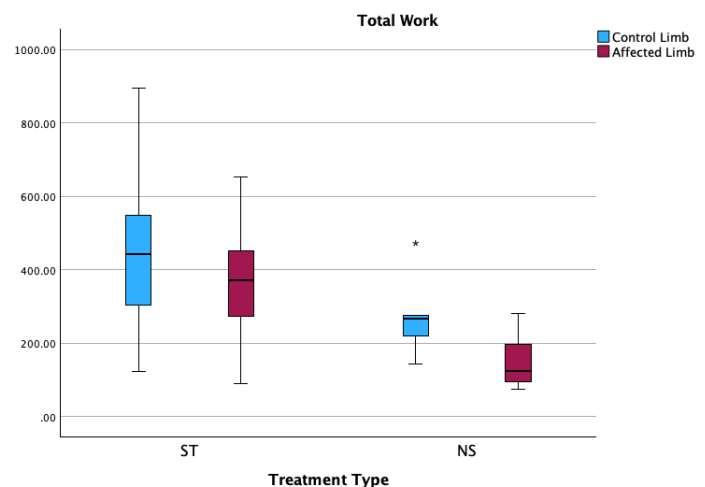
Results: There were significant differences in all strength parameters except elbow flexion work fatigue in the affected arm between the ST and NS groups. Significant differences were also observed between the control arm and affected arm in all strength parameters except forearm supination peak torque. No significant differences were observed between the three surgical groups (DR, AR, HFR).

Discussion: Patients with missed or late-presenting distal biceps injuries may be presented with a variety of treatment options, including surgical and non-surgical treatment. This is the first study to compare functional outcomes of distal biceps tendon injury in four distinct groups. The preliminary data from this study may help surgeons choose an appropriate surgical technique and inform patients on their expected recovery.

Conclusion: Patients with a distal biceps tendon rupture treated surgically demonstrated statistically significantly greater peak torque, total work and work fatigue in the affected arm than those treated non-surgically, both in forearm supination and elbow flexion.

Acknowledgements: COREF

COREF Funded: Yes



Abstract Type: Full

Research Pillar: Clinical Research

Title: Assessment of Radiographic Healing Reliability and Accuracy in Distal Radius Fractures

Authors: Erin Davison, Phillip Spanswick, Daniel You, Murray Wong, Danielle Whittier, Ryan Martin, Robert Korley, Steven Boyd and Prism Schneider

Background: Distal radius fractures are one of the most common injuries treated by orthopaedic surgeons. The majority of these fractures are treated non-operatively with closed reduction and cast immobilization. Despite the prevalence, both duration of immobilization and radiographic criteria to define fracture union lack consensus. Fracture healing is often determined clinical by assessing patient pain and function, combined with radiographic cortical continuity and callus. Radiographic scoring systems using fracture line visibility, visible callus, and bridging callus have been validated in lower limb fractures. A study by Patel et al. modified these scoring systems for distal radius fractures, finding moderate inter- and intra-rater reliability; however, this scoring system was not validated against other parameters used to assess distal radius fracture healing, such as patient reported outcomes, functional measures, or in vivo measures of fractures healing. In this study, we hypothesized that radiographic assessment based on cortical continuity and fracture line visibility in non-operatively treated distal radius fractures would provide a reliable and valid measure of fracture healing.

Methods: Six independent physicians (two senior orthopaedic residents, two orthopaedic trauma fellows, and two fellowship-trained orthopaedic trauma attendings) scored 60 radiographs from 20 participants with non-operatively treated distal radius fractures. Radiographs were obtained at 2-, 4- or 6-, and 26-weeks post-fracture. Radiographs were scored three separate times with a two-week washout period in between radiographic review. In the final scoring round, patient demographics were unblinded.

Fracture line visibility, callus, and bridging callus were scored at each time point. Additionally, raters scored fracture union and decided if cast removal was appropriate based on their overall impression. Fracture stiffness recovery was calculated from micro-finite element models generated from high-resolution peripheral quantitative computed tomography images acquired at each time point as a percent change from scans taken of their contralateral side at the first time point. Wrist pain and function was captured through Patient-Rated Wrist Evaluation (PRWE) at each time point.

Results: A total of 20 participants and 60 radiographs were reviewed, with a mean age of 50.5 ± 15.8 years and 90% being female. Moderate intra-rater reliability was found for the radiographic score across the first two rounds of scoring (correlation coefficient = 0.69), which was stronger compared to fracture union (correlation coefficient = 0.56) and cast removal scores (correlation coefficient = 0.54). Reliability within all six raters ranged from moderate to good (correlation coefficient range = 0.69 – 0.73) for the radiographic score, demonstrating stronger agreement than fracture union or cast removal scores. Mean radiographic, fracture union, and cast removal scores were strongly associated with stiffness based on the micro-finite element models and wrist pain/function, based on the PRWE.

Discussion and Conclusion: In conclusion, this study demonstrates the radiographic cortex score is a reliable and valid measure of fracture healing progression. The radiographic cortex score addresses the lack of consensus regarding the radiographic criteria used to define fracture union. In addition, this study highlights the weaker reliability associated with both the determination of fracture union and the decision to continue cast immobilization; therefore, supporting the need for an objective radiographic measure. We recommend the use of the radiographic cortex score to inform the radiographic evaluation of non-operatively treated DRFs, in order to help inform decision-making for cast removal.

Acknowledgements: Workers Compensation Board of Alberta, University of Calgary Department of Surgery Clinical Research Fund, Calgary Orthopaedic Research and Education Fund, and McCaig Institute for Bone and Joint Health.

COREF Funded: Yes

Abstract Type: Full

Research Pillar: Clinical Research

Title: Volar Cortical Displacement Reliably Predicts Delayed Displacement of Distal Radius Fractures

Authors: Calgary Orthopaedic Resident Research Group (CORRG), Kim Rondeau and Prism Schneider

Background: Distal radius fractures (DRFs) comprise 18% of adult fractures. Up to 40% of DRFs initially managed non-operatively will subsequently displace and require surgery. Treatment is based on patient factors and radiographs at the time of injury and follow-up, yet predicting which DRFs will displace following initial reduction is challenging. Delayed displacement requiring surgery is associated with worse functional outcomes, increased complications, and prolonged recovery. This study aimed to assess the reliability and validity of radiographic parameters in predicting delayed displacement of DRFs.

Methods: A multi-centre retrospective cohort study and concurrent case-control study of adult patients with DRFs was performed. Eligible patients were identified using diagnostic codes from the Alberta Health Services Data Integration, Measurement and Reporting (DIMR) provincial database. A cohort of patients ≥ 18 years with an isolated DRF and minimum three-month follow-up was obtained to measure reliability of radiographic parameters. Pre- and post-reduction radiographs were reviewed by a minimum of three independent raters to assess volar tilt, radial inclination, ulnar variance, radial height, radiocarpal alignment, intra-articular step-off and gap, volar cortical displacement, dorsal comminution, and cast index. Intraclass correlation coefficient (ICC) was calculated for pre-reduction and post-reduction parameters. An age- and sex-matched cohort of patients who underwent surgical fixation for delayed displacement was subsequently identified to assess validity of radiographic parameters. A multivariable conditional logistic regression analysis was performed to identify radiographic parameters that were predictive of conversion from non-operative to operative treatment.

Results: A total of 213 patients were included in the retrospective cohort (mean age = 50 ± 14 years; 81% female). Pre-reduction volar cortical displacement demonstrated the highest reliability across reviewers (ICC = 0.73). Moderate reliability was observed for pre-reduction sagittal intra-articular gap (ICC=0.64), as well as pre- and post-reduction volar tilt (ICC = 0.51 and 0.68, respectively).

A total of 168 patients were included in the case-control portion of the study (mean age = 49 ± 14 years; 87% female). Pre-reduction radial inclination, radial height, and volar cortical displacement, and post-reduction radial inclination, radial height, volar cortical displacement, and ulnar variance were predictive of conversion to operative management due to delayed displacement (all $p < 0.05$).

Discussion: This study identified multiple radiographic predictors of delayed displacement for DRFs. Pre- and post-reduction radial inclination, radial height, and volar cortical displacement, as well as post-reduction ulnar variance were significant predictors of delayed displacement. This study identified volar cortical displacement as a novel reliable and valid predictor of delayed displacement of DRFs requiring subsequent surgery. These insights highlight the complexity of determining optimal management of DRFs and emphasize the importance of numerous radiographic parameters in guiding clinical decision-making and the potential for the development of a predictive model.

Conclusion: Volar cortical displacement, radial inclination, radial height, and ulnar variance were identified as predictors of delayed DRF displacement and conversion to operative management. These parameters may help inform earlier surgical decision-making.

Acknowledgments: We wish to thank Dr. Jessica Duong for her support of this project.

COREF Funded: Yes

Abstract Type: Proposal

Research Pillar: Basic Science

Title: Feasibility of Navigation-assisted Arthroscopic Knee Ligament Reconstruction

Authors: Timothy Lasswell, Ryan Martin, Stewart McLachlin and Teresa Marotta

Background: In arthroscopic knee ligament reconstruction, the goal is to replace the injured ligament with a graft that restores the native kinematics and dynamics of the joint. However, guaranteeing tunnel positions that will generate the desired graft strain profile (isometric or anatomic strain) is difficult and there are two problems. The first is that the ideal tunnel placement is not known for each individual patient, so the decision is based on recommendations from the literature that were developed from aggregate data. The second is that once the tunnel location has been selected, ensuring that the selected tunnel location is accurately drilled intraoperatively is challenging and errors in tunnel placement can lead to knee instability or graft rupture. Navigation technology can be applied to knee arthroscopy to solve both problems by developing a preoperative planning, and intraoperative execution, workflow. This project proposes to test the feasibility of a navigation system intended to aid surgeons in selecting the ideal position, and accurate placement, of their graft tunnels to ensure optimal graft performance. The hypothesis is that Navigation-assisted arthroscopic knee ligament reconstruction is expected to more accurately produce the surgeon's desired graft strain curve compared with traditional un navigated arthroscopic knee ligament reconstruction.

Methods: The proposed study design is a pre-clinical, basic science, experimental study to be conducted on non-cadaveric anatomic knee models (Tactile Orthopaedics, Calgary AB) in a lab environment. ACL reconstruction has been chosen as the control procedure for this experiment due to the high-volume nature of this procedure. Multiple surgeons will first be asked to pre-operatively define the strain curve that they want their ACL graft to achieve (isometric or anatomic) and then attempt to recreate these curves by marking the tibial and femoral start points for their graft tunnels using a navigated awl. Two scenarios will be tested. The first scenario will ask the surgeons to mark the tunnel start points using a traditional, un navigated, awl technique. The second scenario will ask the surgeons to mark the tunnel start points using the novel navigated awl developed for this project. Optical tracking cameras (NDI, Waterloo ON) will then be used to generate the strain curves associated with each tunnel placement. This data will then be compared to the pre-operative strain curves and the distance from the actual tunnel location compared to the pre-planned tunnel location will be reported for each scenario. Statistical analysis will consist of assessing the output variable of difference in distance between the drilled tunnel location and planned tunnel location (Δd) for both navigated and un navigated scenarios. Student's t-tests will be used to calculate the p-value when comparing Δd between navigated and un navigated scenarios. If the data detects a significant difference in Δd between navigated and un navigated scenarios, then the strain curves associated with each Δd will be qualitatively assessed to determine whether this statistical difference is likely to contribute to a clinical difference.

Results: Due to the proposal nature of this abstract, results are not yet available.

Discussion: The proposed project will establish a new application for navigation assisted surgery in the field of arthroscopic knee ligament reconstruction. This project is the first step in developing a navigation-assisted knee arthroscopy system that addresses the problems related to graft tunnel position/accuracy and can be translated into clinical practice to increase the consistency of surgery by providing surgeons with more objective data intraoperatively that will allow them to execute their preoperative plan.

Conclusions: Success of this feasibility study will justify further resource allocation to refine the described navigation technology with the ultimate goal of minimizing postoperative complications such as instability, graft rupture or failure to return to sport.

Acknowledgements: COREF, Tactile Orthopaedics

COREF Funded: Yes

Abstract Type: Proposal

Research Pillar: Basic Science

Title: Evaluation of Scapholunate Ligament Injury on Weight Bearing CT

Authors: Brodie Ritchie, Sarah Manske and Neil White

Background: Scapholunate interosseous ligament (SLIL) injuries are a leading cause of wrist instability, however the reason for significant pain while under load is not understood. Without an intact SLIL and secondary stabilizers, dissociation of the scaphoid and lunate results in altered loading mechanics, however, the nature of these mechanical changes and their involvement in subsequent post-traumatic deformity is not well quantified. In foot and ankle, weight bearing computed tomography (WBCT) has become an increasingly important tool in the diagnosis and preoperative planning of complex pathologies as it provides better assessment of alignment, instability, and joint space incongruencies under load bearing conditions. Like the foot and ankle, wrist pain tends to occur with load bearing activities, and yet there has been minimal assessment of the carpal bones under load. This project will be the first to utilize WBCT to assess carpal bones under load. We believe that differences in position under load between healthy and SLIL injured populations will further our understanding of carpal mechanics and advance decision making in complex wrist reconstruction surgery.

Methods: This prospective cohort study is approved under University of Calgary REB21-0803. Ten individuals with SLIL injury and ten healthy controls will undergo bilateral unloaded and weight bearing CT scans in a cone beam CT scanner (total radiation dose <90 μ Sv). The primary outcome measures in this study will be the scapholunate angle, radiolunate angle, capitulunate angle, scapholunate interval, dorsal scaphoid translation, and radio-capitate index, as measured on unloaded CT scan vs. WBCT scan in wrist extension and neutral position. CT scans will be binarized using semi-automated bone-enhancement graph cut technique to generate masks of the carpal bones. A standard coordinate system for the carpal bones of the wrist will be applied and subsequently, angles and distances between bones can be calculated in Python using methods previously developed by our research group. Paired t-tests will be used to compare the carpal bone measurements between controls, injured wrists, and contralateral wrists from injured patients.

Results: This project is currently underway, with ten healthy and ten SLIL patients currently scanned. We hypothesize that measurements will differ between controls and patients with SLIL injury, with WBCT demonstrating increased differences in clinically relevant carpal bone measurements compared to non-weight bearing CT.

Discussion: Findings from this research will establish (1) feasibility of WBCT in the hand and wrist and (2) further our understanding of normal and pathologic carpal bone mechanics under weight-bearing conditions to advance surgical decision making in complex hand and wrist pathology. Limitations include the small sample size.

Conclusion: We believe that wrist WBCT offers the potential to gain a deeper understanding into both normal and abnormal carpal bone pathophysiology, which can inform treatment and ultimately improve outcomes for patients with complex hand and wrist pathologies, including SLIL injury. Future directions include investigating a spectrum of conditions such as scapholunate advanced collapse and scapholunate and scaphoid nonunion advanced collapse arthritis, dynamic vs. static scapholunate interosseous ligament injury, and eventually perilunate dislocations. The long-term goal of this research is to improve surgical decision making and technique surrounding SLIL injury.

Acknowledgements: McCaig Clinician Scientist Seed Grant, American Society of Hand Surgery Resident and Fellow Fast Track Grant, Calgary Surgical Research Development Fund Grant

COREF Funded: Yes

Abstract Type: Proposal

Research Pillar: Clinical Research

Title: Optimal Construct for Fixation of Femoral Neck Fractures: A Biomechanical Analysis

Authors: Anna-Lee Policicchio, Ifaz Haider, Helena Greene, Scott Willms, Andrew Caines, Joshua Mang and Prism Schneider

Background: Femoral neck fractures (FNF) in young patients typically results in unstable vertical shear fractures. Fixation failure rates range as high as 30-50%; therefore, the optimum construct for fixation remains controversial. Augmented constructs with mini-fragment plates and fixed-angled devices are being used to generate increased stability and may minimize complication rates. Presently, there are no cadaveric biomechanical studies comparing the stability of augmented femoral neck fixation using a Pauwels screw, an inferior buttress plate, or the Femoral Neck System. This study aims to compare the biomechanical properties of these constructs using cadaveric models to determine if an optimal configuration can be identified.

Methods: In this biomechanical analysis, cadaveric 24 proximal femurs will be osteotomized to simulate unstable Pauwels type III (70-degree vertical angle) FNFs with posteromedial comminution. The models will be randomized to one of six fixation constructs based on CT scan assessment of bone mineral content and each construct will undergo non-destructive and load-to-failure testing in four separate cadavers. The constructs to be tested include: (1) Three cannulated screws (7.3mm) in an inverted triangle configuration augmented with a Pauwels screw; (2) Three cannulated screws (7.3mm) in an inverted triangle configuration augmented with a non-locking, inferior buttress plate (5-hole, 2.7mm limited contact plate); (3) 135-degree, 4-hole DHS and a Pauwels screw; (4) 135-degree, 4-hole DHS augmented with a non-locking, inferomedial buttress plate (5-hole, 2.7mm limited contact plate); (5) Femoral Neck System; (6) Femoral Neck System with a non-locking, inferomedial buttress plate (5-hole, 2.7mm limited contact plate).

Using the MTS 858 Mini Bionix, each FNF model will be loaded cyclically to establish torsional stiffness and axial stability. Next, construct failure strength will be measured under monotonic compressive load, in a direction consistent with peak load during gait. Demographic data from the specimens will be reported and compared using t-tests and Chi-square analysis. Kruskal-Wallis test followed by Dunn's test will be used to evaluate stiffness and strength differences between each construct.

Results: Across all specimens, the mean age is 66.7 years (\pm SD), with five of the 24 femurs being female (19.2%). One-way ANOVA demonstrated no significant differences in bone mineral content between groups (Figure 1). Based on this analysis, the randomized groupings of specimens can be used to reliably evaluate mechanical differences between each construct.



Figure 1. One femoral specimen with construct fixation using cannulated screws.

Discussion: This will be the first biomechanical study using cadaveric specimens to compare different augmented FNF fixation constructs. Within this unique subset of hip fractures, implant choice and bone quality are important factors affecting fracture healing and outcomes for young patients. The results of this study will help guide surgical decision-making and may inform a future prospective clinical trial.

Conclusion: This study may support novel, augmented configurations for FNF fixation to better withstand physiologic hip forces and decrease the high complication rates seen in young patients with FNFs.

Acknowledgements: Biomechanics Lab in the McCaig Institute for Bone and Joint Health, the COREF resident grant and the Calgary Surgical Research and Development Fund grant, Foothills Orthopaedic Trauma Research Team, Dr. Jessica Duong.

COREF Funded: Yes.

Abstract Type: Proposal

Research Pillar: Clinical Research

Title: Incidence and Risk Factors for Arthrofibrosis After Primary ACL Reconstructive Surgery: A Systematic Review

Authors: Alyssa Federico*, Reva Ye Qiu* and Nicholas Mohtadi (*co-first authors)

Background: The anterior cruciate ligament (ACL) is the most commonly injured ligament of the knee, accounting for half of all knee injuries. Up to 76.6% of ACL ruptures require surgical reconstruction, most commonly in active or high demand patients. However, there is a high rate of complications following ACL reconstructive surgery, with 28% of patients requiring a second operation. One common complication is knee stiffness, or arthrofibrosis. There is no clear definition as to what constitutes arthrofibrosis, resulting in variable measures of incidence and uncertainty about potential risk factors. Therefore, the primary aim of this study is to identify the incidence and risk factors for stiffness and arthrofibrosis in adult patients following primary ACL reconstructive surgery. A secondary aim of this study is to identify the incidence of repeat surgical intervention for post-operative stiffness and arthrofibrosis.

Methods: Two independent reviewers conducted a systematic review according to the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) guidelines. EMBASE, MEDLINE, and PubMed databases were searched with no restrictions. The database searches yielded a total of 383 unique papers. Primary research studies were included if they met the following criteria: (1) studied adult patients with primary ACL ruptures that were treated surgically; (2) provided a clear definition of post-operative stiffness or arthrofibrosis; (3) had a minimum follow-up period of 3 months post-operative, and (4) reported the incidence or risk factors for post-operative stiffness or arthrofibrosis. Data extraction is currently underway. Following data extraction, statistical analysis and quality assessment of selected papers will be performed using the Methodological Index for Non-Randomized Studies (MINORS) and the Risk of Bias 2.0 protocol.

Results: N/A

Discussion: N/A

Conclusion: N/A

Acknowledgments: We would like to thank the University of Calgary Sport Medicine Center research team for their assistance and support.

COREF Funded: No

Abstract Type: Proposal

Research Pillar: Health Services Research

Title: Impact of Social Determinants of Health on Access to Primary Total Hip and Knee Arthroplasty in Public Healthcare Settings: A Scoping Review

Authors: Mallika Makkar, Kaela Schill, Laura Morrison and Marcia Clark

Background: Osteoarthritis (OA) affects approximately eight percent of the global population; this number continues to rise with population ageing. It hampers productivity and contributes to chronic pain, disability, and poor mental health. Arthroplasty surgery can effectively alleviate the pain and loss of function associated with hip and knee OA. However, patients may experience variable access to it based on social determinants of health (SDoH) like income, housing, and education. The extent that SDoH may influence public delivery of orthopaedic surgical care is unknown. If existing delivery methods are not equipped to account for population-level variations in SDoH, inequities surrounding arthroplasty may inadvertently persist. Under the Canada Health Act, individual provinces must mitigate barriers to healthcare access. The growing need for hip and knee arthroplasty therefore calls on our healthcare delivery systems to account for any impacts of SDoH on arthroplasty access. This review aims to examine the SDoH that affect access to publicly funded arthroplasty, with the ultimate goal of dismantling barriers that could improve population-level musculoskeletal health.

Methods: This scoping review will follow the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews Checklist. A comprehensive strategy will be used to search PubMed, EMBASE, MEDLINE, and CINAHL for relevant studies. References of included studies and grey literature will be hand-searched. Four reviewers will screen abstracts and full-texts in tandem using a standardised screening tool in Covidence. Conflicts will be resolved by group discussion. English language studies concerning impacts of SDoH on access to primary total hip or knee arthroplasty in regions with Universal Health Coverage Service Coverage Index of 80% or greater will be included. Subdomains within access will include provider access, indication detection, progression to surgery, and receipt of optimal care.

Results: A data extraction tool will be developed iteratively and used to report study characteristics and key findings. Qualitative content analysis will be performed on included studies. The results will be shared in a peer-reviewed publication and conference presentations.

Discussion and Conclusion: Understanding the barriers to arthroplasty is crucial in planning health prevention and promotion strategies, determining health resource allocations, and service planning and implementation strategies. This scoping review will illuminate key findings and identify opportunities for future research and patient advocacy to facilitate systemic change.

Acknowledgements: None

COREF Funded: No

Abstract Type: Proposal**Research Pillar:** Clinical Research**Title:** Use of High-Resolution Peripheral Quantitative Computed Tomography to Determine the Effect of Early Weightbearing on Fracture Union in Ankle Fractures**Authors:** Alyssa Federico, Topher Flanagan, Andrew Dodd, Paul Duffy, Herman Johal, Rob Korley and Prism Schneider

Background: Ankle fractures are among the most common fractures treated by orthopaedic surgeons. Evidence supports that early weightbearing in stable Weber B ankle fractures treated non-operatively has favourable clinical outcomes; however, there is little investigation into the effect of early weightbearing on fracture healing. High-resolution peripheral quantitative computed tomography (HR-pQCT) can be used for assessment and quantification of bone microarchitecture and fracture healing, with a low level of radiation exposure. Our research group has used serial HR-pQCT with micro finite element analysis to quantify fracture healing successfully in the setting of distal radius fractures. Therefore, the primary aim of this study is to apply this technique to quantify the effects of early weightbearing on time to fracture union and quality of fracture healing, as measured by HR-pQCT. The secondary aim of this study is to quantify the effect early weightbearing has on clinical outcomes in patients with stable Weber B ankle fractures.

Methods: The proposed study is a single centre, randomized controlled trial. We will begin with a pilot study of 50 patients, which is a sample size of convenience to ensure feasibility. Adult patients with stable Weber B ankle fractures amenable to non-operative treatment will be recruited from the Foothills Medical Centre Cast Clinic. Eligible participants must be enrolled within 21 days of the index injury. Inclusion and exclusion criteria are further detailed in Table 1. Patients will be randomized into two groups: early weightbearing within 21 days of injury or non-weightbearing for six weeks post-injury. Subsequent assessments will occur at 6-, 8-, and 12-weeks, and six- and 12-months post-injury. Functional outcome measures will include ankle range of motion, strength, and screening for complications. Patient-reported outcome measures will include a pain visual analogue scale, American Orthopaedic Foot and Ankle Society Hindfoot score (AOFAS), and Foot and Ankle Ability Measure (FAAM). Kinematic and dynamic gait parameters, such as peak and mean plantar pressures, will be analyzed with custom pressure sensing shoe insoles (Xsensor, Calgary, AB). Radiographic union will be measured by two independent assessors using a modified Radiographic Union Scale in Tibia (mRUST) score. Additionally, HR-pQCT will be obtained bilaterally within 21 days of injury, and then unilaterally on the injured side during each follow-up assessment. HR-pQCT parameters of interest for evaluating fracture healing will include bone mineral density (total, cortical, and trabecular) and trabecular bone volume. Statistical analysis will include independent samples T-tests and Chi-square analysis, as appropriate.

Result/Discussion/Conclusion: N/A

Acknowledgements: We would like to thank the Foothills Orthopaedic Trauma Research Team, especially K. Witges and J. Duong for their assistance, and the Worker's Compensation Board of Alberta for funding support.

COREF Funded: No

Inclusion Criteria	Exclusion Criteria
Patients \geq 18 years old and skeletally mature	Pre-existing ankle fracture, arthritis, or deformity on either side
Stable Weber B ankle fracture amenable to non-operative treatment	History of neuropathy or other disease leading to decreased sensation in the foot
Assessed in cast clinic within 21 days of index injury	History of rheumatoid arthritis or other inflammatory arthropathy
Willing and capable to provide consent	Currently on chronic corticosteroid treatment (>3 months)
Willing to comply with study protocols	Currently pregnant or planning pregnancy within 6 months
Able to attend follow-up evaluations	Concomitant injury that precludes weightbearing protocol
	Cognitive or communication barriers that impede completion of questionnaires
	Consistent pre-injury use of a walking aid

Table 1: Inclusion and exclusion criteria.

Abstract Type: Proposal

Research Pillar: Clinical Research

Title: Evaluation of the Novel Volar Cortical Displacement Parameter as a Radiographic Predictor of Delayed Distal Radius Fracture Displacement

Authors: Kaja Matovinovic, Erin Davison and Prism Schneider

Background: Distal radius fractures (DRFs) comprise 17% of all adult fractures. Many of these injuries are successfully managed non-operatively with closed reduction and immobilization with casting. However, some DRFs that are deemed appropriate for conservative management at the time of injury, can demonstrate displacement over time, resulting in delayed operative management. Delayed operative management can prolong rehabilitation time for patients and can pose unique technical challenges for surgeons. Recent studies have identified radiographic parameters at time of injury that may be predictive of DRFs that are likely to fail conservative management. Decreased pre-reduction radial height, decreased pre-reduction radial inclination, and volar cortical displacement have been shown to be significant predictors of delayed fracture displacement at two-weeks post-injury. We hypothesize that the novel volar cortical displacement is a predictor of delayed fracture displacement that may be used to help inform earlier surgical decision-making. Therefore, the aim of this study is to further define volar cortical displacement and to assess the validity and accuracy of the ability of this radiographic measurement to predict delayed displacement.

Methods: We will perform a retrospective cohort study of skeletally mature adults with DRFs. Inclusion criteria will be patients 18 years of age or older, with an isolated DRF successfully treated with closed reduction and casting. Exclusion criteria will be patients with multiple injuries or surgically treated DRFs. We will assess volar cortical displacement on lateral wrist radiographs by measuring the distance between the volar cortex of the distal radial fracture fragment and the volar cortex of the radial metaphysis. Measurements will be taken from radiographs at the time of injury (pre-reduction), following closed reduction, and at the 2-week post-injury follow-up. These measurements will be validated using high resolution computed tomography (CT) scans at the 2-week time point.

Intra-rater reliability will be calculated with observers measuring volar cortical displacement at two separate time points with a minimum of a 2-week washout period. Inter-rater reliability will also be calculated by having three independent assessors with varying level of experience measure volar cortical displacement at two separate time points with a minimum of a 2-week washout period.

Results: N/A

Discussion: N/A

Conclusion: To our knowledge, this will be the first study to describe the novel radiographic parameter of volar cortical displacement, and to assess its validity in comparison to high resolution CT scans. Further characterization of radiographic features that may be predictive of delayed fracture displacement may also be helpful in guiding initial management of patients. By identifying DRFs that are likely to fail non-operative management at the time of injury, both patients and surgeons will be able to mitigate the negative sequelae of delayed surgical intervention.

Acknowledgements: Calgary Orthopaedic Resident Research Group

COREF funded: No

Abstract Type: Full

Research Pillar: Clinical Research

Title: Timely Hip Fracture Surgery in Adult Hip Fracture Patients Receiving Pre-Injury Anticoagulation: A Prospective Study

Authors: Stephanie Gibbon, Haiyan Hou, Julie Fisher, Casandra Tan, Jessica Duong, Golpira Elmi Assadzadeh and Prism Schneider

Background: Anticoagulation use for prevention and treatment of thrombotic and embolic events is increasingly common. As the global population ages, hip fracture incidence is also increasing, where up to 40% of hip fracture patients are taking an oral anticoagulant (OAC) at the time of their injury. Pre-injury OAC use can result in delayed time-to-surgery (TTS) and increased complications and mortality. There are currently no guidelines for safe and timely surgical management of hip fracture patients receiving pre-injury OAC. The aim of this pilot study was to evaluate the residual pre-operative OAC levels in patients requiring urgent hip fracture surgery.

Methods: This is a subgroup analysis of a prospective cohort of patients 50 years or older with a hip fracture requiring urgent surgery. Residual pre-operative OAC (pOAC) levels were analyzed upon admission and pre-operatively if TTS was ≥ 24 hours from injury (STA Compact Max, Stago) and described relative to time from last dose. Participants were dichotomized into those with and without elevated pOAC level. Renal function, adverse events, prothrombin time, and blood transfusions were collected. A decrease in hemoglobin levels from hospital admission to post-operative day 1 (POD1) were compared. T-tests, Mann-Whitney U, and Fisher Exact tests were used, as appropriate.

Results: In total, 95 patients with hip fractures without pre-injury OAC use (mean age = 75.9 [\pm 11.6] years, with 69% being female) and 11 patients receiving Apixaban were included with nine having normal renal function (mean age = 85.6 [\pm 8.7] years, with 71% being female). There was no difference in sex distribution between those receiving OAC or not, but those receiving OAC were significantly older ($p=0.03$).

The mean time from last dose to pre-operative blood draw was 37.3 (\pm 31.0) hours and mean residual pOAC level was above the normal reference range (0-23 ng/mL) at 54.3 (\pm 46.7) ng/mL. There was no difference in prothrombin level between those with elevated pOAC level and those without ($p>0.05$). There was no significant difference in hemoglobin level between those receiving OAC (-12.1 ± 14.8 g/L) and those not (-20.3 ± 18.4 g/L; $p=0.14$). There was no significant difference in transfusion rates within 48 hours of surgery between groups ($p=1.0$). There were no cardiac, pulmonary, or thrombosis-related adverse events within the 3-month follow-up for those on OAC.

Discussion: This pilot study supports that patients with normal pre-operative renal function who undergo surgical management within 48 hours from last OAC dose did not experience any additional adverse events. There is currently a paucity of high-quality prospective data to guide safe and timely surgical intervention for patients sustaining a hip fracture requiring urgent surgical management while on pre-injury OAC despite the increase in incidence of hip fracture presentation and OAC use in this high-risk population.

Conclusion: Safe and timely surgical care of hip fracture patients on OACs is a global health priority, given the potential to decrease morbidity and mortality. This study supports that patients with normal pre-operative renal function who undergo surgery within 48 hours from their last OAC is likely safe and warrants further investigation.

Acknowledgements: We wish to thank members of the Foothills Orthopaedic Trauma Research Team.

COREF Funded: Yes

Abstract Type: Full Abstract**Research Pillar:** Clinical Research**Title:** Lower Implant Removal Rates Occur Following Posterolateral Antiglidle Fixation for Distal Fibula Fractures**Authors:** Logan Woods, Golpria Elmi Assadzadeh and Prism Schneider

Background: Distal fibula fractures are a common injury, often requiring surgical management. Surgical fixation techniques described include intramedullary fixation, tension band wiring, lateral plating, locked compression plating, and antiglide plating. Biomechanical studies have shown antiglide plating to be superior to lateral plating. Additionally, lateral implants can result in soft-tissue irritation; despite this, lateral plating remains the most commonly performed technique. We hypothesized that the posterolateral antiglide plating technique will have lower rates of implant removal, wound complication, infection, and overall secondary surgery rates.

Methods: A multi-centre retrospective observational cohort study was performed using data from the Alberta Health Services Data Integration, Measurement and Reporting (DIMR) repository. Included patients were 18 years of age and older with an isolated ankle fracture that underwent surgical fixation within Alberta from July 1st to December 31st, 2016, and July 1st to December 31st, 2019. Patients had a minimum of two post-operative follow-up visits. Those with multiple injuries, open fractures, pathologic fractures, and pre-existing ankle implants were excluded.

Continuous variables are reported as means and standard deviations. Categorical variables are reported as number and proportions. Pearson's Chi-squared, Wilcoxon rank sum, fisher tests and t-tests were used as appropriate. Pairwise analysis was used to compare fixation groups and odds ratios were used to report odds of reoperation for implant removal based on fixation technique.

Results: A total of 1525 patients were included (55.9% Female). Mean age of included patients was 47 years (SD 17.2yrs). The majority of fractures were classified as Weber B (81.9%); 43.7% of patients had posterior malleolar fractures and 46.4% had medial malleolar fractures. Lateral plating was the most commonly performed fixation technique at 74.2%. A total of 23.8% of all included patients

underwent reoperation for implant removal. The rate of reoperation for implant removal of each fixation type is listed in Table 1. Pain (51.4%), Syndesmosis removal (27.3), and infection (9.1%) were the most common reasons for implant removal, respectively.

Discussion: Lateral plating continues to be the most commonly used method of distal fibular fixation. The overall rate of reoperation for implant removal (23.8%) was similar to previously published rates of reoperation. Posterolateral antiglide plating had the lowest rate of reoperation for implant removal of all fixation types and was over 2 times less likely to be removed compared to lateral plating, while locking plates were 2.5 times more likely to require removal.

Conclusions: Reducing healthcare costs is important to stakeholders including patients, surgeons, administrators, and employers. The current study suggests that posterolateral plating for the treatment of rotational distal fibula fractures may lead to lower instance of reoperation for implant removal and therefore decreased cost. This study provides support for a future prospective study to compare posterolateral fibula fixation to other forms of fixation.

Acknowledgements: Foothills Orthopaedic Trauma Research Team, especially Stephanie Yee and Dr. Jessica Duong

COREF Funded: Yes

Table 1: Mean age and Implant removal, based on fixation type

	Fixation Type					
	Lateral plate N=1131	Posterolateral antiglide plate N=252	Locking compression plate N=76	Dual plate N=45	IM fixation N=20	Tension band N=1
Mean age*	46.5	42.9	62.4	51.5	60.6	48
Implants removed	297 (26.3%)	37 (14.7%)	18 (23.7%)	7 (15.6%)	4 (20.0%)	1 (100%)
Odds ratio¹	2.17 (1.39-3.53)	1.00	2.51 (1.19-5.22)	1.58 (0.54-4.11)	1.61 (0.28-6.21)	NA

* p<0.001

¹ 95% confidence interval

Abstract Type: Full

Research Pillar: Clinical Research

Title: Robotic Assessment of Post-call Sensorimotor and Cognitive Function in Orthopaedic Surgery Residents

Authors: Laura Morrison, Molly Joffe, Mark Piitz, Matt Chilvers, Faizal Kassam, Fred Nicholls, Golpira Assadzadeh, Sean Dukelow and Prism Schneider

Background: Sleep deprivation can negatively affect cognitive reasoning, complex decision-making, and motor function; all of which are necessary skills for surgical residents. Robust evidence regarding the effects of sleep deprivation on surgical residents is lacking. Despite this, orthopaedic surgery residents are required to work extended duty hours including 26-hour (26h) overnight call shifts. The KINARM robot is used to precisely measure sensorimotor function and cognitive reasoning in patients with stroke, traumatic brain injuries, and neurodegenerative diseases. Therefore, the aim of this study was to evaluate KINARM standard tests (KSTs) as a surrogate measure of the skills required to perform surgery and make critical decisions related to surgery, and to determine if resident performance is adversely affected in a post-call versus a pre-call state.

Methods: This is a prospective cohort study involving orthopaedic surgery residents at a Level One Trauma Centre. Following informed consent, residents wore a portable sleep-tracking device (WHOOP 3.0) for 14 days, which collected information regarding sleep quality and quantity. Residents were assessed using six KSTs at five time points: orientation, pre-call shift 1 (baseline data), post-call shift 1, post-call shift 2, and post-call shift 3. The KSTs included tasks such as Object Hit, a test of bimanual sensorimotor control, where participants use virtual paddles to hit balls that fall from the top of the screen with increasing speed and frequency. Object Hit and Avoid (OHA) introduces additional cognitive demands, where participants are instructed to only hit two specific shapes of targets and avoid six shapes that serve as distractors. At each time point, residents also performed the Purdue Peg Board Test (PPT) to assess fine motor skills.

Self-reported caffeine intake, call volume, quality of life, and educational satisfaction were collected using various surveys. All KSTs were examined based on their task score, which is a normalized global measure of task performance. Some task scores were further analyzed based on individual parameters within the test. For example, within OHA, additional parameters include Object Processing (number of objects correctly processed per second), Target Hits (percentage of balls hit) and Hand Speed. Linear mixed models were used to assess the effects of 26H shifts, sleep and caffeine intake on resident performance on KSTs and the PPT over the two-week study period.

Results: A total of 10 residents participated in the study. The mean age was 28 (SD=1.2) years, five (50%) participants were female, and all were right-handed. The mean total minutes slept while on call was 189 (SD=134) minutes, or 3 hours and 9 minutes, versus 416 (SD=118) minutes or 6 hours and 56 minutes, while not on call. The mean caffeine intake in the 24 hours prior to assessment was 220.6mg (SD=204.9mg) or the equivalent of a medium drip coffee. There were no significant fixed effects of 26h shifts, sleep or caffeine on the global task performance for any of the KSTs or the PPT. However, several parameters within each KST demonstrated fixed and/or interaction effects. For example, within the Object Hit and Avoid task, Object Processing demonstrated a statistically significant fixed effect of 26h Shifts ($p=0.04$). Target Hits (percentage of balls hit) and Hand Speed demonstrated an interaction effect of 26h Shifts x Sleep ($p=0.03$ and $p=0.05$, respectively).

Discussion: The KINARM robot has been used clinically to assess disturbances of motor control in a variety of neurologic conditions; however, the application of its use in post-call surgical residents is novel. This highly sensitive test found that resident performance on many of the KSTs was not significantly affected by post-call status from 26h shifts, prior sleep or prior caffeine intake. However, the OHA test, which requires skills akin to surgical performance (bimanual dexterity, cognition, accuracy, and speed) had several parameters that were negatively affected by 26h shifts and lack of sleep.

Conclusion: This study investigated the effects of sleep deprivation and 26h shifts on orthopaedic surgery residents' performance using KINARM standard tests. While global task performance may not be significantly impacted, specific parameters related to surgical skills may be impacted by sleep deprivation. These findings emphasize the importance of further exploring the effects of sleep deprivation on surgical residents, in order to help promote safe and healthy surgical training.

Acknowledgements: COREF

COREF Funded: Yes