



ORTHOPAEDIC RESEARCH DAY

May 20, 2021 | 8:00 AM – 5:00 PM PST

THURSDAY, MAY 20, 2021

Chair: Dr. Henry Broekhuysse

Review Panel: Dr. Lise Leveille, Dr. Babak Shadgan, Dr. Adrian Huang

Note:

1. All presentations are strictly limited to **6 minutes**, followed by a **4 minute** discussion period with the review panel
 2. All attendees are encouraged to submit questions using the Zoom “Chat” function. Presenters will respond to these questions using Zoom “Chat” after their presentation has been completed.
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0800 – 0805:

Welcome and Opening remarks – Dr Kishore Mulpuri

Morning Research Presentations (6 min. presentation + 4 min. discussion)

0805 – 0815:

Mikaela Peters (R3) - Effect of Orthopaedic Resident Education on Screening for Intimate Partner Violence (Dr. Kelly Lefavre)

0815 – 0825:

Hannah Nazaroff (R3)- The State of Musculoskeletal Education in Canadian Family Medicine Training Programs (Dr. Adrian Huang)

0825 – 0835:

Mary Sun (R2)- Is there a need for musculoskeletal ultrasound education in Canadian orthopaedic surgery programs? (Dr. Henry Broekhuysse)

0835 – 0845:

Taylor Crown (R2) - Assessing the quality of a residency training program and Competency by Design in Orthopaedic Surgery (Dr. Fay Leung, Dr. Henry Broekhuysse)

0845 – 0855:

Lynn Murphy (Clinical Fellow)- Gender Diversity, Leadership, Promotion and Opportunity among the Members of the Orthopaedic Trauma Association (Dr. Kelly Lefavre)

0855 – 0905:

Azita Sharif Ahmadian (Graduate Studies) - Development of a Statistical Shape and Intensity Models of Eroded Scapulae to Improve Shoulder Arthroplasty (Dr. Josh Giles)

0905 – 0915:

Daniella Crocker (R2) - Does Intraoperative Vancomycin Powder Affect Postoperative Infections in Adolescent Idiopathic Scoliosis? (Dr. Firoz Miyanji)



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0915 – 0925:

Eryck Moskven (R1) - Factors Associated with Increased Length of Stay in Degenerative Cervical Spine Surgery: Cohort Analysis from the Canadian Spine Outcomes and Research Network (CSORN) (Dr. John Street)

0925 – 0935:

Mohamed Al-Amoodi (R1) - The Effect Of Sarcopenia On Early Mortality And Adverse Events After Emergent Surgery For Spinal Fractures In Patients With Ankylosing Spondylitis (Dr. John Street)

0935 – 0945: Break

0945 – 0955:

Kellen Walsh (R3) - Acute reverse total shoulder arthroplasty versus open reduction and internal fixation, total shoulder arthroplasty, hemiarthroplasty and non-operative management of acute proximal humerus fractures in the elderly: A systematic review and meta-analysis (Dr. Adrian Huang)

0955 – 1005:

Akshay Lobo (R3) - Intraoperative assessment and accuracy of glenoid base plate insertion in total shoulder arthroplasty (Dr. Danny Goel)

1005 – 1015:

Helen Crofts (R1) - Initial glenoid component position does not affect short-term clinical and radiologic outcomes in total shoulder arthroplasty (Dr. William Regan)

1015 – 1025:

Hanny Chen (R1) - Implementation of a novel rapid access shoulder clinic: A pilot project (Dr. Adrian Huang)

1025 – 1035:

Maciej Simon (Clinical Fellow) - Systematic review of surgical results of chronic distal biceps ruptures (Dr. Parth Lodhia)

1035 – 1045:

Islam Elnagar (Clinical Fellow) - Elbow hemiarthroplasty versus total arthroplasty for the treatment of distal humerus fracture (Dr. Farhad Moola)

1045-1055: Break

1055 – 1105:

Colby Finney (R3) - Radiographic Determination of the Distal Ulnar Diaphyseal Angle (DUDA) (Dr. Parham Daneshvar)

1105 – 1115:

Gabriel Larose (Clinical Fellow) - he Trajectory of Long-Term Recovery Following ORIF for Distal Radius Fractures (Dr. Kelly Lefavre)

1115 – 1125:

Stefan St George (R4) - The Recurrence rate of diffuse Tenosynovial Giant-Cell Tumour of the knee following staged open synovectomy (Dr. Paul Clarkson)



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1125 – 1135:

Alex Hoffer (R4) - Follow-up After ACL Reconstruction: How Long is Long Enough? (Dr. Jordan Leith)

1135 – 1145:

Doug Kingwell (Clinical Fellow) - ACL hamstring graft preparation: A modified technique to significantly reduce your time on the back table (Dr. Jordan Leith)

1145 – 1155:

Matthew Hickey (Graduate Studies) - Does Use of Navigation or Robotics Reduce TKA Revision Rates Enough to Justify Broad Adoption? A Simulation-Based Power Analysis (Dr. Anthony Hodgson, Dr. Bas Masri)

1155 – 1300: Lunch

Afternoon Research Presentations: (6 min. presentation + 4 min. discussion)

1300 - 1310:

Aresh Sepehri (R4) – Does Pelvic Arterial Embolization Increase Surgical Site Infection in Trauma Patients Undergoing Pelvic Ring Fixation (Dr. Pierre Guy)

1310-1320:

Aly Alsaifan (R3) – Fractures of the Pelvic Ring: Factors Predictive of Arterial Pelvic Hemorrhage Requiring Embolization, and Complications Associated with Embolization (Dr. Pierre Guy)

1320– 1330:

James Yan (Clinical Fellow) - Outcomes in resuscitative endovascular balloon occlusion of the aorta (REBOA) in hemodynamically unstable patients with pelvic ring injuries: A systematic review (Dr. Darius Viskontas)

1330 – 1340:

Prashant Pandey (Graduate Studies) - What are the Optimal Targeting Visualizations for Performing Surgical Navigation of Iliosacral Screws? A Crossover Trial (Dr. Anthony Hodgson, Dr. Pierre Guy)

1340 – 1350:

Michael Nitikman (R4) - Nonmodular Tapered Fluted Titanium Stems Perform Reliably at Medium Term in Revision THR (Dr. Lisa Howard)

1350 – 1400:

Abdul Almeshari (R2) - Return to High Intensity Sport Following Hip and Knee Arthroplasty (Dr. Nelson Greidanus)

1400 – 1410:

Emily Bliven (Graduate Studies) - A Novel Method for Observing Hip Fracture during Impact Simulating a Sideways Fall (Dr. Peter Crompton, Dr. Pierre Guy)

1410 – 1420:

Carly Jones (Graduate Studies) - dGEMRIC T1 is Reduced in Cartilage Overlying Bone Marrow Lesions in the Hip (Dr. David Wilson)



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1420 – 1430:

Luke Johnson (Graduate Studies) - Digitally reconstructed radiographs to evaluate the effect of patient position on hip migration percentage (Dr. David Wilson, Dr. Kishore Mulpuri)

1430 – 1440:

David Stockton (R5) - Unreamed Intramedullary Nailing versus External Fixation for the Treatment of Open Tibial Shaft Fractures in Uganda: A Randomized Clinical Trial (Dr. Peter J O'Brien)

1440 – 1450: Break

1450 – 1500:

Njalalle Baraza (Clinical Fellow) - Health Related Quality of Life in Children with Fibular Hemimelia (Dr. Anthony Cooper)

1500 – 1510:

Tess Carswell (Graduate Studies) - Sex differences in spatiotemporal gait parameters of transtibial amputees (Dr. Josh Giles)

1510 – 1520:

John Steyn (R3) - Cost Analysis and outcome differences for staged vs non-staged pes planovalgus foot reconstruction (Dr. Andrea Veljkovic)

1520 – 1530:

Tanya MacDonell (R2) - Levels of Evidence for Joint-Preserving Surgeries in Ankle Osteoarthritis: 2021 Update (Dr. Alastair Younger, Dr. Murray Penner)

1530 – 1540:

Paul Kulyk (Clinical Fellow) - Catastrophic Polyethylene Failure in the Scandinavian Total Ankle Replacement (STAR): An Analysis of Patient and Implant-related Factors (Dr. Murray Penner)

1540 – 1550:

Charlotte Allen (Clinical Fellow) - Bony Ankle Impingement: Does SPECT scan uptake correlate with location and severity of pain? (Dr. Andrea Veljkovic)

1550 – 1600:

Diogo Cardoso (Clinical Fellow) - Association of alignment and anterior ankle impingement (Dr. Andrea Veljkovic)

1600 – 1610:

Masoud Malakoutian (Graduate Studies) - Biomechanical Properties of Paraspinal Muscles in Adult Spinal Deformity Patients – A Preliminary Analysis (Dr. Thomas Oxlund)

1610 – 1620:

Dynai Eilig (Clinical Fellow) - Soft tissue procedures as treatment for planovalgus deformity (Dr. Andrea Veljkovic)

1620-1630:

Review Team Closing Comments

1630: Adjourn

Orthopaedic Research Day Abstracts

0805-0815 Effect of Orthopaedic Resident Education on Screening for Intimate Partner Violence – Dr. Mikaela Peters (R3)

Authors: **Peters**, Mikaela J; Roffey, Darren M; Lefavre, Kelly A
Supervisor: Dr. Kelly A Lefavre

PURPOSE: Intimate Partner Violence (IPV), which was already prevalent in women presenting to fracture clinics, has been exacerbated during the COVID-19 global pandemic. Educational programs can improve the readiness of residents to manage IPV. However, not all orthopaedic surgery residency programs in Canada provide formal IPV training. Our aim was to determine the effect of various types of educational experiences on IPV knowledge and IPV screening to inform best-practices in resident education.

METHODS: Cross-sectional online survey distributed by email. Resident demographics, IPV educational experiences, IPV knowledge, and frequency of IPV screening were collected via a modified version of the Physician Readiness to Manage Intimate Partner Violence Survey (PREMIS). Descriptive statistics and regression modeling were used to identify predictors of IPV actual knowledge and frequency of IPV screening.

RESULTS: 88 participants (84%) participated in classroom training, 40 (39%) underwent mentorship training, 34 (32%) received both classroom training and mentorship, while 11 (10%) reported neither. Classroom training had no statistically significant association with IPV knowledge or frequency of IPV screening. Residents who received mentorship were 4.1 times more likely to screen for IPV (95% CI: 1.72-10.05), older residents (>35 years of age) were more likely to screen for IPV than younger residents (OR: 8.3, 95% CI: 2.64-29.84), and senior residents were less likely to screen for IPV than junior residents (OR: 0.29, 95% CI: 0.09-0.82).

CONCLUSIONS: Classroom training was not associated with any discernable effect on IPV knowledge nor the frequency of IPV screening. Educational efforts should be targeted at increasing mentorship opportunities in order to improve IPV screening practices in Canadian orthopaedic residents.

0815-0825 The State of Musculoskeletal Education in Canadian Family Medicine Training Programs – Dr. Hannah Nazaroff (R3)

Author: **Nazaroff**, Hannah
Supervisor: Dr. Adrian Huang

PURPOSE: Musculoskeletal (MSK) disorders continue to be a major cause of pain and disability worldwide. The mission statement of the Canadian Orthopaedic Association (COA) is to “promote excellence in orthopaedic and musculoskeletal health for Canadians,” and orthopaedic surgeons certainly serve as leaders in addressing and improving musculoskeletal health.

However, patients with MSK complaints most commonly present first to a primary care physician. In fact, according to a prior survey of family physicians in British Columbia, 13.7-27.8% of patients present with a chief complaint that is MSK-related. Therefore, providing excellent MSK care to Canadians requires that all physicians, especially those involved in primary care, have been adequately trained to diagnose and treat common conditions. To date, there has been no assessment of the total mandatory MSK training Canadian family

medicine residents receive. It is also unclear, despite the prevalence of MSK complaints among Canadian patients, if current family physicians are competent or confident in their ability to provide fundamental MSK care. The purpose of this study is to determine the amount of mandatory MSK training Canadian family medicine residents are currently receiving.

METHODS: Web-based research was used to determine how many weeks of mandatory MSK training was incorporated into current Canadian family medicine residency training programs. This information was gathered from either carms.ca or residency program's individual websites. If this information was not available on a program's website, a program administrator was contacted via email in order to ascertain this information directly. MSK training was considered to be any rotation in orthopaedic surgery, spine surgery, sports medicine, or physiatry.

RESULTS: 156 Canadian family medicine residency training sites were identified. Information pertaining to mandatory MSK education was collected for 150 sites (95.5%). Of the 150 training sites, 101 (67.3%) did not incorporate any mandatory MSK training into their curriculum. Of the 49 programs that did, the average number of weeks of MSK training was 3.37 weeks. 32/49 programs (65.3%) included 4 weeks of MSK training, which represents 3.8% of a 2-year training program.

CONCLUSION: Current Canadian family medicine residents are not receiving sufficient musculoskeletal training, especially when compared to the overall frequency of musculoskeletal presentations in the primary care setting. Understanding current family medicine physicians' surveyed confidence and measured competence with respect to diagnosing and treating common musculoskeletal disorders could also prove helpful in demonstrating the need for increased musculoskeletal education. Future orthopaedic initiatives could help enhance family medicine MSK training.

0825-0835 **Is there a need for musculoskeletal ultrasound education in Canadian orthopaedic surgery programs? – Dr. Mary Sun (R2)**

Author: **Sun, Mary**
Supervisor: Dr. Henry Broekhuysen

INTRODUCTION: In recent years there has been an increasing interest in using ultrasound as an alternative imaging modality in both diagnostic and therapeutic applications involving musculoskeletal disorders in medicine. The aim of this study is to conduct a survey of current opinions of MSKUS training in Canadian orthopaedic residency programs and identify whether a possible gap that exists in training.

HYPOTHESIS: We hypothesized that the uptake and usage of musculoskeletal ultrasound (MSK US) in Canadian orthopaedic programs is limited by the lack of current use in clinic practice by orthopaedic surgeons. This is likely influenced limited access to ultrasound machines and training courses, as well as the inability to be paid for the extra time taken to conduct bedside MSK US exams.

METHODS: An online survey of current Canadian orthopaedic surgeons and trainees was developed using the Qualtrics survey platform to assess their attitudes, practice intentions and familiarity with MSK ultrasound. The survey was distributed anonymously using a link and email solicitation through the COA Research Newsletter and was available for response between 01-30 Jun 2020.

RESULTS: Of the 186 respondents, 119 (64%) were surgeons and learners comprised the remainder of respondents. Only 21.9% (N=23) of currently practising surgeons surveyed

employed MSK US in their practice and 3.57% (N=2) of learners were using ultrasound in their training programs. Of the individuals not currently using MSK US 80% (N=84) of surgeons and 78.57% (N=44) of learners expressed interest in learning. Lack of time and educational opportunities were the most cited barriers to using MSKUS by more than half of surgeons and learners. Additionally, 68.5% (N=72) of surgeons surveyed cited inability to bill for MSK US exams and procedures as a barrier to its use.

CONCLUSION: Despite high levels of interest from orthopaedic surgeons and learners, the slow uptake of MSK US in Canadian orthopaedic practice and training maybe influenced by limited educational resources, lack of time and billing codes. Incorporating MSK US training into residency training in addition to advocacy may alleviate some of this short fall.

0835-0845 **Assessing the quality of a residency training program and Competency by Design in Orthopaedic Surgery – Dr. Taylor Crown (R2)**

Author: **Crown**, Taylor

Supervisors: Dr. Fay Leung, Dr. Henry Broekhuysse

INTRODUCTION: The Royal College of Physicians and Surgeons of Canada introduced a new competency-based education model, Competency by Design (CBD) to all disciplines in 2014 [1]. It involves residents advancing in their training by completing pre-determined skills, named entrustable professional activities (EPA's) with a sufficient level of competence [2]. A rotation is completed once all EPA's are achieved [3]. The redirection to a CBD model shifts the educational dynamic, giving more responsibility to the residents to guide and seek learning opportunities. Several universities in Canada initiated preliminary roll-outs prior to the Royal College launch in 2014 that showed that residents participating in the CBD model demonstrated accelerated competency and knowledge in surgical skills compared to their peers trained in the traditional program with some residents completing their residency earlier than the allocated five years [4].

Much of the research on CBD discusses program framework and resident's perspectives and there is a lack of evaluating a resident's self-perceived competency throughout their training [5]. The University of British Columbia (UBC) Orthopaedic Residency department introduced the CBD model in 2020 to their current PGY-1 residents. We propose to complete a qualitative survey to determine the effect of CBD on current residents' self-perceived competency. In conjunction with this assessment, we will initiate an internal quality assessment of the UBC orthopaedic program.

PURPOSE & HYPOTHESIS: The primary objective is to compare the resident's self-evaluated competency of EPA's and orthopaedic procedures between residents who have trained through the CBD model with residents who have not. Secondary objectives include an overall evaluation of the UBC orthopaedic program.

The main purpose is to determine the effectiveness of the newly enrolled CBD training on orthopaedic surgery residents at UBC. Other motives are to assess the orthopaedic program and identify any areas requiring improvement. We hypothesize that a CBD education model will enhance the residents self-regarded competency of orthopaedic skills to proficiently practice in orthopaedics.

METHODS: Two surveys will be distributed to all current UBC orthopaedic residents on a yearly basis; a competency survey and a program survey with the following categories: basic information, future plans, curriculum, assessment and evaluation, research and scholarship, learning environment, resident wellness and program evaluation. The surveys will be distributed through one45 and will be anonymized. Comments on general themes identified between PGY years will drive the overall discussion of the results.

RESULTS: The surveys are scheduled to be distributed by the end of this academic year. Results are pending.

CONCLUSION: The Orthopaedic Trauma service at Vancouver General Hospital operates on a wide distribution of injuries ranging from simple daycare procedures to complex polytrauma. Currently, there is no algorithm for opioid prescribing and we expect to see significant variability in discharge prescription patterns. A standardized prescribing protocol and routine outpatient follow up dedicated to narcotic weaning monitoring are required to limit excessive opioid use and minimize contribution to the growing opioid crisis in our province and community.

REFERENCES:

- [1] "Understanding Competence By Design." The Royal College of Physicians and Surgeons of Canada, 2021, www.royalcollege.ca/rcsite/cbd/competence-by-design-cbd-e. Accessed 24 April 2021.
- [2] Harris, K. A., et al. "Competency-based resident education - The Canadian perspective." *Surgery*, vol. 167, 2020, pp. 681-684.
- [3] Ferguson, Peter C., et al. "Three-year Experience with an Innovative, Modular Competency-Based Curriculum for Orthopaedic Training." *The Journal of Bone and Joint Surgery*, vol. 95-A, no. 21, 2013, p. e166.
- [4] Nousioainen, Markku T., et al. "Eight-year outcomes of a competency-based residency training program in orthopaedic surgery." *Medical Teacher*, vol. 40, no. 10, 2018, pp. 1042-1054.
- [5] Blades, M. L., et al. "Resident Perspectives on Competency-By-Design Curriculum." *Journal of Obstetrics and Gynaecology Canada*, vol. 42, no. 3, 2020, pp. 242-247.

0845-0855 **Gender Diversity, Leadership, Promotion and Opportunity among the Members of the Orthopaedic Trauma Association – Dr. Lynn Murphy (Clinical Fellow)**

Authors: **Murphy**, Lynn; Miller, Anna; Roffey, Darren; Lefavivre, Kelly
Supervisor: Dr. Kelly Lefavivre

PURPOSE: Orthopaedic surgery is historically one of the most gender imbalanced specialties, and this is even more evident in orthopaedic trauma as a subspecialty. The Orthopaedic Trauma Association (OTA) is the central academic body of the subspecialty and recognizes the importance of diversity. In 2020, they announced the formation of a task force, with the goal of developing a 3-year plan to improve diversity as well as creating a diversity policy for the organization. To achieve a goal, a baseline state of gender diversity for the organization should be established, particularly as it relates to inclusion and opportunities, both inside and outside of the OTA. Our aim is to demonstrate the current gender distribution in professional promotion and leadership positions of OTA members both within and outside of the OTA. We hypothesize that there will be a significant difference between genders.

METHODS: We conducted a cross-sectional examination of the currently available membership listing data at OTA.org (n=2,608). Detailed demographic information on professional and academic listings of OTA members at their site of appointment was abstracted and analyzed. Data fields captured included: gender, membership type, trauma fellowship completion, trauma practice setting, level of trauma center, percentage of trauma work, year of first practice, institutional/university leadership and leadership roles (commencement by year) within the OTA. Statistical testing included Chi-Squared test, Wilcoxon Two Sample test and Fishers exact test.

RESULTS: 2608 members were identified; of these 14.1% are female. Female representation is highest in the Trauma Practice Professional membership subgroup at 67.1% and was significantly lower in all other membership subgroups, with only 9.1% of females in the active subgroup ($p < 0.0001$). This pattern persists throughout all countries of origin. There are no statistically significant gender differences between level of trauma center ($p = 0.4$), percentage of trauma work ($p = 0.82$), or academic community vs academic university setting ($p = 0.6$). Men were more likely to have completed trauma fellowship ($p < 0.0001$). The number of years in practice was significantly less for females than their male counterparts ($p < 0.0001$). Men were more likely to hold the highest leadership positions ($p = 0.0047$) and the greatest number of positions ($p = 0.017$) within the OTA.

CONCLUSION: Analysis of our findings serves to highlight the continued gender disparity within orthopaedics and trauma as a subspecialty. Gender bias hinders opportunities for female leadership and promotion within the trauma community. Results from this study will help inform strategic policy to address diversity within the organization and subspecialty.

0855-0905 **Development of a Statistical Shape and Intensity Models of Eroded Scapulae to Improve Shoulder Arthroplasty – Azita Sharif Ahmadian (Graduate Studies)**

Authors: **Ahmadian**, Azita Sharif; Giles, Joshua W
Supervisor: Dr. Joshua W Giles

PURPOSE: To achieve optimal surgical treatment for patients with complex glenoid erosion, it is critical to gain insight into the scapula's full shape and bone property variation. Statistical Shape Modeling (SSM) mathematically quantifies and enables the visualization of full bone shape variation in a systematic manner rather than describing discrete anatomical features. Statistical Intensity Modeling (SIM) produces similar descriptions of variation but for bone density. These methods can identify abnormalities, assist in surgical planning and developing improved implant designs. The main objective of this study is to develop SSM and SIM of pathological eroded scapulae.

METHODS: To create an SSM, a set of patient scapula models with identical 3D surface mesh structures is required. Initial scapula geometries were obtained from 61 CT images using Mimics (Materialise NV). Then, using a Non-Rigid registration algorithm, a source mesh was automatically morphed to match the shape of each bone in our training dataset. Creating an SIM also requires a set of bone models represented by volumetric mesh structures with the same number of nodes and node locations. To achieve this, a volumetric mesh morphing algorithm was used to deform a source volume mesh to the shape of all other bones, while maintaining the nodal structure. The mesh morphing process was implemented using FEM software (ABAQUS) with surface node deformations derived from the above Non-Rigid registration and defined as displacement boundary conditions. Intensity data (Hounsfield Unit (HU) values from each scapula's CT images) are assigned as field data to each volume element. After that, Principal Component Analysis (PCA) was performed across all the deformed source meshes and volume datasets to create SSM and SIM that describe the independent modes of variation in the training set. Finally, the robustness of our SSM was evaluated through compactness, specificity, and generality metrics.

RESULTS: The SSM's first mode of variation represents uniform size variation, the second describes changes in Critical Shoulder Angle (CSA) and scapula height, and the third relates closely to glenoid size and acromial tilt (i.e. shifting from superoanterior to posterior). Regarding compactness, the first 9 modes of variations accounted for 95% variability, while the generality is 2.75 mm, and the calculated specificity over 10,000 instances for two modes of variation is 2.45 mm. The SIM's first mode of variation accounts for overall changes in intensity across the entire bone (456.8 ± 108.7 HU), while the second represents localized

changes in the glenoid vault bone quality. The third shows changes in intensity at the posterior and inferior glenoid rim associated with posteroinferior glenoid rim erosion.

CONCLUSION: This SSM demonstrated the morphological variation within a patient population with varying degrees of glenoid erosion. These results will enable future investigations to compare this population to healthy populations already reported in the literature. SIM also showed regional variations in intensity characteristic of a glenoid erosion patient population. This can be used as a source for generation of FE models with systematically varied bone properties to understand of the biomechanics of various treatment options for patients with glenoid erosion.

KEYWORDS: Statistical shape and intensity a, bone morphology, shoulder arthroplasty, anatomical measurement, density distribution.

0905-0915 **Does Intraoperative Vancomycin Powder Affect Postoperative Infections in Adolescent Idiopathic Scoliosis? – Dr. Daniella Crocker (R2)**

Authors: **Crocker**, Daniella; Singh, Supriya
Supervisor: Dr. Firoz Miyanji

SUMMARY: This study compares wound complications, infection rates, and reoperation rates for adolescent idiopathic scoliosis (AIS) patients treated with intraoperative vancomycin powder compared to those who were not. The results show that in AIS patients receiving intraoperative vancomycin powder, the rate of deep wound infection and associated reoperation rate is significantly lower than the no vancomycin group.

HYPOTHESIS: Intraoperative vancomycin powder does not affect the rate of postoperative wound infections in AIS.

STUDY DESIGN: Retrospective multicentre review

INTRODUCTION: The routine use of intraoperative vancomycin powder to prevent postoperative wound infections has not been borne out in the literature. The goal of this study is to determine the impact of vancomycin powder on postoperative wound infection rates and determine its potential impact on microbiology.

METHODS: AIS patients that underwent a posterior fusion from 2004-2016 were analyzed. A retrospective comparative analysis of postoperative infection rates was done between patients that received vancomycin powder to those who did not. Statistical significance was determined using Chi-squared test. Additionally, the microbiology of infected patients was examined.

RESULTS: 765 patients in the vancomycin group (VG) were compared to 504 patients in the non-vancomycin group (NVG). NVG had a significantly higher rate of deep wound infection ($p < 0.0001$) and reoperation rate compared to VG ($p < 0.0001$). Both groups were compared for age, gender, race, weight, surgical time, blood loss, number of levels instrumented, and preop curve magnitude. There were significant differences between the groups for race ($p < 0.0001$); surgical time ($p = 0.0033$), and blood loss ($p = 0.0021$). In terms of microbiology, VG grew *s.aureus* ($n = 2$), *p.acnes* ($n = 2$), and *serratia* ($n = 2$), whereas NVG grew *proteus* ($n = 1$) and *p.acnes* ($n = 1$). The remaining cultures were negative.

CONCLUSIONS: Vancomycin appears to contribute significantly to deep wound infection prevention and associated reoperations. Vancomycin does not seem to alter the microbiology of deep wound infections. It should be noted that the VG included a surgical time range up to 2018 as compared to NVG (2016). Other institutional changes may have

also occurred over this time, in addition to the use of vancomycin, which may have affected the infection rates.

TAKE HOME POINT: Intraoperative use of vancomycin powder reduces deep wound infection rates and associated reoperation surgery in AIS.

0915-0925 **Factors Associated with Increased Length of Stay in Degenerative Cervical Spine Surgery: Cohort Analysis from the Canadian Spine Outcomes and Research Network (CSORN) – Dr. Eryck Moskven (R1)**

Authors: **Moskven**, Eryck; Street, John; Charest-Morin, Raphaële; Canadian Spine Outcome Research Network (CSORN) Research Members.

Supervisor: Dr. Raphaële Charest-Morin

INTRODUCTION: Prolonged length of stay (LOS) following spine surgery incurs an increased cost for patients and hospitals. Only small studies have investigated the association of patient, surgical, and preoperative factors on LOS following commonly performed cervical spine procedures.

OBJECTIVES: The objectives were to report on variability and determine factors associated with prolonged LOS in Canada following anterior cervical discectomy and fusion (ACDF) of less than three levels and posterior cervical fusion (PCF).

METHODOLOGY: This is a retrospective study of prospectively collected multicentre data consisting of patients enrolled in the CSORN between January 2015 and October 2020. Patient demographics, cervical pathology, symptom duration and severity, preoperative patient-reported outcomes, surgical centre, perioperative AEs, and LOS were abstracted. Multivariable logistic regression analysis was performed to determine the association and odds ratio for risk-adjusted factors on prolonged postoperative LOS, defined as greater than the median LOS per procedure. Bootstrapping statistical techniques were used to internally validate the prediction models.

RESULTS: A total of 1085 patients were included (ACDF n=670, PCF n=415). Mean (\pm SD) LOS for the ACDF cohort was 2.0 days (\pm 2.5) compared to the PCF cohort of 5.7 days (\pm 4.9) days. Median ACDF LOS was 1.0 day (Interquartile Range [IQR], 0-45) and 5.0 days (IQR, 1-57) for the PCF cohort. Predictors of prolonged LOS following ACDF were female gender (odds ratio [OR] 1.59, 95% confidence interval [CI] 1.10-2.30, p=0.013), longer operation time (OR 1.015, 95% CI 1.010-1.020, p<0.001), greater intraoperative blood loss (OR 1.003, 95% CI 1.00-1.010, p=0.032), and the occurrence of any perioperative AEs (OR 4.47, 95% CI 2.31-8.66, p<0.001). Predictors of prolonged LOS following PCF included the occurrence of any perioperative AEs (OR 4.66, 95% CI 2.78-7.83, p<0.001), non-marital status (OR 1.85, 95% CI 1.14-2.99, p=0.013), \leq high-school education (OR 1.69, 95% CI 1.09-1.69, p=0.02), and non-smoking status (OR 1.77, 95% CI 1.05-3.00, p=0.032). Internal validation ROC curves yielded high correct classification values.

CONCLUSIONS: Our study identified several patient, surgical, and procedural factors predictive of prolonged LOS following ACDF or PCF. Further studies are needed to determine if quality improvement strategies targeted at enhanced recovery after surgery improve patient care quality and reduce LOS.

0925-0935 **The Effect of Sarcopenia On Early Mortality And Adverse Events After Emergent Surgery For Spinal Fractures In Patients With Ankylosing Spondylitis – Dr. Mohamed Al-Amoodi (R1)**

Authors: **Al-Amoodi**, Mohamed
 Supervisor: Dr. John Street

PURPOSE: Frailty is considered to be a state of decreased resistance and resilience to internal and external stressors and can occur independent to chronological age. Patients with chronic disease, such as ankylosing spondylitis, have been found to be at a higher risk of deconditioning, loss of muscle mass and frailty. Prior studies have attempted to evaluate sarcopaenia in a practical fashion by using axial computed tomography (CT) scanning to measure the total area of the psoas muscle. In order to quantify frailty, there have been multiple scoring systems developed, most notably the modified Frailty Index, which have been shown to predict mortality and complications post spinal surgery. While frailty is shown to be a predictor of complications and adverse outcomes in patients undergoing spinal surgery, and recent work has demonstrated sarcopaenia to be a predictor of mortality rates in patients with spinal metastases undergoing surgery, the use of frailty and sarcopaenia to predict complications and mortality in patients with ankylosing spondylitis undergoing surgery for spinal fractures remains unknown.

HYPOTHESIS:

1. Internal validation study, which aims to show that sarcopaenia is a good measure of frailty in patients with ankylosing spondylitis and that the disorder in itself is not a confounder
2. Demonstration of a significant association between frailty, sarcopaenia and adverse outcomes

METHODS: Descriptive analysis will be conducted and the prevalence of sarcopaenia will be estimated with 95% confidence intervals. Linear regression modelling will be used for mortality. Logistic regression will be used for dichotomous outcomes. Confounders (e.g. complexity of surgery, age and sex) will be adjusted for in statistical analysis.

COHORT: Multicentre, retrospective. 1) Mater Misericordiae University Hospital in Ireland, 2) UBC at VGH, and 3) U of T at Sunnybrook. Duration: 2009-2019. At UBC: 108 patients. Inclusion: all patients who underwent emergency surgery with ankylosing spondylitis. Exclusion: metastatic disease.

UPDATE:

1. CREB approval granted
2. 1 more VCH Department signature to submit VCHRI application
3. Data sharing agreement was reviewed and needs to be distributed to each site for signatures

0935 – 0945 REFRESHMENT BREAK

0945-0955 **Acute reverse total shoulder arthroplasty versus open reduction and internal fixation, total shoulder arthroplasty, hemiarthroplasty and non-operative management of acute proximal humerus fractures in the elderly: A systematic review and meta-analysis – Dr. Kellen Walsh (R3)**

Authors: **Walsh**, Kellen; Sepehri Aresh
 Supervisor: Dr. Adrian Huang

PURPOSE: Proximal humerus fractures in the functional elderly are a challenging problem to treat. Poor quality confers high rates of failure in open reduction and internal fixation and hemiarthroplasty has poor clinical outcomes. Non-operative treatment has formed the mainstay of treatment, however reverse total shoulder arthroplasty (rTSA) has generated increased clinical interest. The purpose of this study is to compare outcomes in acute reverse total shoulder arthroplasty against those of open reduction and internal fixation, total shoulder arthroplasty, hemiarthroplasty and non-operative management.

METHOD: A systematic review of the literature was conducted on Ovid Medline and Embase, Web of Science and the Cochrane database using MESH terms specific to each database to maximize search sensitivity. Results then underwent preliminary title and abstract screening, followed by full text screening by two independent reviewers. Inclusion criteria were acute proximal humerus fracture, treatment includes rTSA performed acutely, must only include patients older than 65 years of age, at least one outcome measure reported and study must be a comparative study. Exclusion criteria consisted of: treatment performed for non-acute proximal humerus fractures, non-union, sequelae of proximal humerus fractures, or pathologic fracture, case report/series under 10 patients, absence of a full text publication or English language translation, expert opinion, and cadaveric studies.

RESULTS: Initial searches yielded 1629 studies from 4 sources, of which 513 duplicates were removed. 1116 publications underwent title and abstract screening for relevance to the study question, of which 196 progressed to full article assessment for eligibility. The remainder of study results are pending.

CONCLUSIONS: Pending

0955-1005 **Accuracy of glenoid baseplate positioning: Comparing intra-operative to post-operative CT scans amongst senior orthopedic residents and expert surgeons – Dr. Akshay Lobo (R3)**

Authors: **Lobo**, Akshay; Lohre, Ryan; Bois, Aaron; Pollock, J; Lapner, Peter; Athwal, George; Goel, Danny
Supervisor: Dr. Danny Goel

BACKGROUND: Glenoid baseplate orientation in reverse shoulder arthroplasty (RSA) influences clinical outcomes. Accurate intra-operative assessment of glenoid position is critical to improved short and long-term outcomes as the majority of surgeons perform less than 20 shoulder arthroplasties per year. Given that base plate positioning is visually determined during surgery, this study aimed to determine the accuracy of baseplate location amongst senior orthopedic residents and expert surgeons.

MATERIALS AND METHODS: Senior residents and expert surgeons determined in person augmented baseplate positions on eight implanted fresh frozen cadavers. Multiple parameters were documented including baseplate version, inclination, augment rotation, and superior-inferior offset. Cadaveric scapula were then dissected and underwent a CT scan. These images were converted to 3D reconstructed radiographs (3DRRs). Glenoid parameters were measured on the 3DRR by two independent observers using a validated technique. Intraclass correlation coefficients (ICCs) were used to determine measurement reliability. Bland-Altman plots were used to compare the accuracy of glenoid orientation in the cadaver and compared to the 3DRR data.

RESULTS: Both senior orthopedic residents and surgeons demonstrated poor accuracy in their cadaveric orientation assessments when compared to 3DRR measured glenoid parameters as determined by ICC values and Bland-Altman plots. Measured repeatability coefficients for residents and surgeons demonstrate variance beyond clinically acceptable

glenoid orientations with +/- 14.4 degrees for version, +/- 13.1 degrees for inclination, +/- 37.6 degrees for augment rotation, and +/- 6 mm for offset. The 3DRR showed greater intra-rater (ICC = 0.99 (95% CI 0.98-0.99)) and inter-rater (ICC = 0.95 (95% CI 0.92-0.96)) reliability than 2D CT (intra-rater ICC = 0.92 (95% CI 0.82-0.96); inter-rater ICC = 0.77 (95% CI 0.64-0.85)) or in-person measurements (inter-rater ICC = 0.84 (95% CI 0.69-0.92)).

CONCLUSION: Comparing in-person assessment to 3DRR measurements showed poor to fair correlation and accuracy for both senior orthopedic residents and expert surgeons in all measured parameters. The 3DRR provided excellent reliability in determining augmented glenoid baseplate orientation. Intra-operative measurement errors in glenoid placement may reach unacceptable clinical limits, potentially predisposing patients to implant failure. The use of navigated methods may increase the reliability of intra-operative decision making.

1005-1015 **Initial glenoid component position does not affect short-term clinical and radiologic outcomes in total shoulder arthroplasty – Dr. Helen Crofts (R1)**

Authors: **Crofts**, Helen; Simon, Maciej JK; Sasyniuk, Treny; Johnston, Kayla; Plausinis, Derek; Zazour, Zane; Leung, Fay; Chin, Patrick; Regan, William
Supervisor: Dr. William Regan

PURPOSE: Proper glenoid positioning is important for the longevity of total shoulder arthroplasty (TSA) and remains the primary source of loosening. The aim of the study was to identify if initial glenoid component malposition affects loosening and influences clinical outcomes at 2 years post-operatively.

METHODS: This prospective study included patients who underwent a TSA with minimum 2 year follow-up. Polyethylene (PE) and trabecular metal (TM) glenoid components were included. Radiographic images taken preoperatively evaluated glenoid wear, inclination, and version. Post-operative assessment also included glenoid component loosening, glenoid component centering and humeral head position. All radiographic measurements were taken by two independent observers, and inter-rater reliability of all variables was calculated via intraclass correlation coefficient (ICC). Clinical assessments include the EQ-5d, SF-12, WOOS and ASES and were recorded at each follow-up visit. Descriptive statistics were calculated for each variable at all time points. Regression modelling and cross-sectional modelling, controlling for age, sex, BMI, dominant arm, and glenoid wear at pre-op, was used to model loosening and clinical outcomes at 2 years compared to post-operative glenoid position.

RESULTS: 92 patients with an average age of 69.9 ± 6.2 years were included in this study. Glenoid component position improved significantly in version ($-19.4 \pm 8.6^\circ$ to $-17.7 \pm 8.5^\circ$; $p < 0.045$) and inclination ($11.5 \pm 7.1^\circ$ to $5.9 \pm 6.3^\circ$; $p < 0.00001$) from preoperative to postoperative. Glenoid component offset and humeral head centering remained unchanged throughout the follow-up. ICC scores showed moderate to good reliability for glenoid version and inclination (0.709-0.838). Loosening (Lazarus classification) was recorded in 21 cases (17.3%) (Lazarus score of 1 in 15 and 2 in 6 cases; 13 PE, 8 TM). Clinical assessments (EQ-5d, SF-12, WOOS and ASES) and range of motion (ROM) showed continuous significant improvements from preoperative scores ($p < 0.05$). Logistic regression modeling showed no correlation between post-operative glenoid position and component loosening at 2 years. Linear regression modelling showed no correlation between post-operative glenoid position and clinical outcome scores.

CONCLUSIONS: Glenoid component positioning following TSA improved version and inclination compared to the pre-operative state. Radiologic loosening of the glenoid component is not negatively reflected in clinical scores or ROM at 2-year follow-up.

1015-1025 Implementation of a novel rapid access shoulder clinic: A pilot project – Dr. Hanny Chen (R1)

Authors: **Chen**, Hanny; Huang, Adrian; Pike, Jeff
Supervisor: Dr. Adrian Huang

PURPOSE: The impact of a rapid access outpatient shoulder clinics in trauma.

BACKGROUND: Shoulder pain is a leading cause of disability in the adult population with a lifetime prevalence of up to 67%.¹ Shoulder pain is also the third most common site of musculoskeletal pain in the community.² Shoulder disorders can often become chronic problems leading to disability resulting in time off work and increased costs imposed on the healthcare system.³

Current 50th percentile times in British Columbia for assessment and treatment for shoulder disorders by a surgical specialist is 11.4 weeks.⁴ The outlook is no better nationally with a median wait time of 13.2 weeks for a referral from a family physician to a specialist and then an additional 20.9 weeks from specialist consultation to treatment.⁵

It is well accepted that early active rehabilitation protocols can help preserve range of motion and assist in prevention of posttraumatic pain and stiffness. This in turn can facilitate faster return to work or normal activities. Frequently used tools such as The Shoulder Pain and Disability Index (SPADI)⁶ and the disabilities of the arm, shoulder, and hand (DASH)⁷ questionnaire offer a snapshot of the current degree of pain and disability due to shoulder pathology. With 70% of all referrals to surgical consultation not requiring surgery, this translates to lost rehabilitation time that can further exacerbate symptoms, loss of range of motion, and impede return to work or normal activities.⁸

In contrast, the establishment of a rapid access outpatient shoulder clinic could help alleviate long wait times for formal orthopedic surgery consultation especially for patients not amenable to surgical intervention. Examples of such include rotator cuff pathology, dislocations, and soft tissue injuries. Starting patients who are not surgical candidates on early rehabilitation protocols to preserve range of motion can assist in the prevention of posttraumatic pain and stiffness. The benefits of a rapid access outpatient shoulder clinic model are twofold. Firstly, early range of motion can facilitate faster return to work or normal activities. Secondly, reduced billing costs of allied health such as physiotherapy in comparison to physicians can lead to cost reductions on the healthcare system.

In summary, the results of this prospective trial can help determine the efficacy of a rapid access outpatient clinic model for shoulder injuries in non-surgical candidates. Consideration for patient outcomes using the DSAH score and SPADI index as well as cost savings to the healthcare system will be analyzed.

OBJECTIVE/HYPOTHESIS: Primary objective is to evaluate the cost and effectiveness of a rapid access outpatient shoulder clinic. Outcomes will be cost of implementation, patient outcomes and satisfaction as measured by the DASH score and SPADI.

EXPERIMENTAL DESIGN:

- I. Study design – Prospective cohort study. Patients will be allocated to the traditional orthopaedic shoulder surgeon at a tertiary academic shoulder centre or to a rapid access outpatient shoulder clinic at the same site.
- II. Inclusion criteria – All patients aged 18 years or older with isolated acute shoulder injuries with no clear indication for immediate surgical intervention.
- III. Exclusion criteria – History of neurologic or muscular disease of either upper extremity, history of significant trauma to either upper extremity, patients with a clear surgical indication, polytrauma patients.

- IV. Sample size (TBD)
- V. Main outcome measures – Disabilities of the Arm, Shoulder and Hand (DASH) score and Shoulder Pain and Disability Index (SPADI).
- VI. Secondary outcome measures – time to return to work, cost benefit of rapid access clinics versus traditional rehabilitation model, referring physician satisfaction.

RESULTS: Currently, no data available for analysis. The project is currently in the design phase as funding is being secured.

CONCLUSIONS: This project will encompass the design, implementation, and assessment of a rapid access shoulder clinic and its effect on both the individual patient as well as the healthcare system as a whole. From the patient perspective, key metrics will be outcomes measured by the SPADI and DASH, patient satisfaction, and time to return to work. From a healthcare systems perspective, cost benefit analysis as well as referring physician satisfaction will be examined.

This is a cross-disciplinary multi-year endeavor paramount on the support from physicians, nursing staff, physiotherapists, occupational therapists, and administration. Currently the project is the early stages in terms of designing the operational flow of the assessment clinic, securing funding, and highlighting the personnel that will be involved in the operations.

The current timeline is to begin patient recruitment in Fall of 2021.

1025-1035 **Systematic review of surgical results of chronic distal biceps ruptures – Dr. Maciej Simon (Clinical Fellow)**

Authors: **Simon**, Maciej JK; Bajwa, Arpun; Leith, Jordan M; Moola, Farhad O; Goetz, Thomas; Lodhia, Parth
Supervisor: Dr. Parth Lodhia

PURPOSE: Distal biceps tendon tears can cause weakness and fatigue in activities requiring elbow flexion and supination. Surgical management of chronic tears is scarcely described in the literature. The aim of this study was to determine clinical outcomes of chronic distal biceps repairs and reconstructions.

METHODS: A search of Medline (Pubmed + Ovid), EMBASE, CINAHL physical therapy, Cochrane Database of Systematic Reviews and Central Register, and PubMed Central from beginning of inception until September 29, 2020 was performed to identify all articles including chronic distal biceps ruptures. All studies with at least one outcome measure and ten patients with chronic distal biceps ruptures that were surgically treated were included in this systematic review. Outcomes assessing physical function and complications were reviewed.

RESULTS: Fourteen studies were included after systematic database screenings. MINORS criteria scores ranged from 5 to 19. A total of 462 cases with chronic distal biceps tendon ruptures were included. Follow-up times ranged from four months to 11 years. Single-incision (n = 4) and two-incision (n = 2), or both (n = 6) surgical techniques were used in these studies. Two studies did not specify the surgical approach. Repairs used transosseous button fixation and suture anchor fixation methods. Four studies describe the use of autografts and 5 articles used allografts in the chronic repair. Range of motion outcomes were excellent when compared to the contralateral arm. Main postoperative complications were paraesthesias, which were temporary in 70% of the cases.

CONCLUSION: Surgical management of chronic distal biceps ruptures demonstrate improvement and overall successful outcomes for pain and function. Although there may be

a slightly higher immediate complication rate, specifically neuropraxia of the lateral antebrachial cutaneous nerve, functional outcomes remain comparable to that seen in the acute distal biceps patient population.

1035-1045 **Elbow hemiarthroplasty versus total arthroplasty for the treatment of distal humerus fracture – Dr. Islam Elnagar (Clinical Fellow)**

Authors: **Elnagar**, Islam; Moola, Farhad; Perey, Bert
Supervisor: Dr. Farhad Moola

PURPOSE: This retrospective study of a cohort of patients with distal humerus fracture over the last ten years (between 2011 and 2020) who were treated with either Total elbow arthroplasty or distal humerus arthroplasty. Patients were recruited from 2011 to 2020 with each patient included in the study having a minimum of one year follow-up to document long term patient satisfaction and outcome measures.

STUDY POPULATION: All patients who had either Total Elbow Arthroplasty or Elbow Hemiarthroplasty over the last 10 years.

Inclusion criteria:

- 1- Distal humerus fractures that were treated with Total Elbow Arthroplasty or Elbow Hemiarthroplasty (plus or minus ORIF).
- 2- Minimum follow up 1 year.

Exclusion criteria:

- 1- Patients who died.
- 2- Patients who had less than one year follow up.

METHODS: Total of 39 patients who had either Total elbow arthroplasty or Hemiarthroplasty for fracture management were reviewed. Six patients were dead (unrelated to the fracture or the operation), therefore they were excluded from the study. Further 16 patients lost follow up were not included in our data. Seventeen patients were included in the study.

We followed the study group for at least one year. We compared both groups (the total elbow arthroplasty and the hemiarthroplasty) according to our outcomes measures which were: VAS score (Visual Analogue Score), DASH score (Disabilities of the Arm, Shoulder and Hand) MEPS (Mayo Elbow Performance Score), Arc of motion and Functional improvement (compared to the pre-injury level).

DATA COLLECTION AND OUTCOME MEASURES: The following data was collected

- 1- Patient age, gender, fracture side and the procedure performed.
- 2- Patients' functional outcomes as compared to their preoperative status (return to work / other activities)
- 3- Follow up and preoperative radiographs. Images were assessed for initial fracture characteristics, post operative alignment, loosening and erosion.
- 4- Reoperation (if any) and the indication.

MEASURES:

- 1- The Disabilities of the Arm, Shoulder and Hand score (DASH)
- 2- Mayo Elbow Performance Score (MEPS)
- 3- The Visual Analogue Score (VAS)
- 4- Arc of motion
- 5- Functional improvement

1055-1105 **Radiographic Determination of the Distal Ulnar Diaphyseal Angle (DUDA) – Dr. Colby Finney (R3)**

Authors: **Finney**, Colby; Daneshvar. Parham; Lohre, Ryan; Finney, Colby
Supervisor: Dr. Parham Daneshvar

PURPOSE: The purpose of this study is to characterize the distal ulnar diaphyseal angle (DUDA) and determine side-to-side, age, and sex effects to DUDA magnitude and location.

METHODS: We defined the DUDA and performed a retrospective analysis of bilateral wrist radiographs on 60 patients. The inflection point was measured from the most distal aspect of the ulnar head and recorded as the DUDA tip-to-apex distance (TAD).

RESULTS: A DUDA was seen in 94% of radiographs. The mean DUDA angle was 5.6 ± 2.6 degrees and the mean TAD was 45.3 ± 9.5 mm.

CONCLUSION: A DUDA was demonstrated, representing a valgus deviation from the center axis and an antero-posterior view of the ulna. Contralateral lateral wrist radiographs are moderate to strongly reliable in determining the DUDA. Rater reliability was good to excellent. Recreation of the DUDA may benefit procedures such as ulnar shortening osteotomy, fractures, or malunion, as it may contribute to DRUJ biomechanics.

1105-1115 **The Trajectory of Long-Term Recovery Following ORIF for Distal Radius Fractures – Dr. Gabriel Larose (Clinical Fellow)**

Authors: **Larose**, Gabriel; Broekhuysse, Henry M; Guy, Pierre; O'Brien, Peter J; Roffey, Darren; Lefaivre, Kelly
Supervisor: Dr. Kelly Lefaivre

PURPOSE: Distal radius fractures are common injuries. There has been a trend towards surgical treatment to improve patient outcomes. However, long-term studies evaluating the trajectory of recovery over time are lacking in the literature. Previous research on this injury has focused on the outcomes of open reduction internal fixation (ORIF), yet most studies have drawn arbitrary endpoints to evaluate the success of this treatment. Trajectory studies help us understand the expected clinical course, which then inform prognosis and research planning.

METHODS: Patients were enrolled between 2005 and 2013 in a prospective trauma database. All patients gave informed consent. Enrolled patients had a distal radius fracture treated by an ORIF at a single level 1 trauma center. Wrist function was assessed using the Patient-Related Wrist Evaluation (PWRE) score, with assessments performed at baseline, 3 months, 6 months, 1 year and 5 years. Medical comorbidities, injury severity score (ISS), age and gender were also recorded. Proportionate change was assessed using Minimal Clinically Important Difference (MCID).

RESULTS: 391 patients were recruited. Mean age was 51 years (standard deviation (SD) 16), 67% of participant were women. Mean pre-injury PWRE score at baseline was 1.3 (SD 3.1). At 3 months, it was 25.8 (SD 20.1). From 3 months to 6 months, there was no statistically significant difference (6 months: 19.7 (SD 17.5) $p=0.68$). Substantive improvement was observed between 6 months and 1 year (1 year: 14.0 (SD 15.5) $p=0.02$); most patients were within MCID from their baseline PWRE score at 1 year (61.5%). Improvement levelled off between 1 year and 5 years (9.4 (SD 13.4) $p=0.27$) – however, of the patients who were not already within MCID from baseline, 30% did achieve MCID in improvement by 5 years. At 5 years follow-up, PWRE scores remained statistically worse compared to baseline ($p=0.01$), while 24% of patients were still at least one MCID from their baseline PWRE score.

CONCLUSION: The trajectory of recovery after ORIF for distal radius fractures showed an initial decline in PWRE scores after surgery, then an incline in trajectory with ongoing substantial disability at 6 months, followed by significant improvements up to 1 year. PWRE scores continued to improve between 1 year and 5 years, albeit to a lesser extent, as demonstrated by patients reporting MCID. Alas, there remains statistically and clinically relevant wrist disability at 5 years following ORIF for distal radius fractures.

1115-1125 **The Recurrence Rate of Diffuse Tenosynovial Giant Cell Tumour of the Knee Following Staged Open Synovectomy – Dr. Stefan St George (R4)**

Author: **St George**, Stefan
Supervisor: Dr. Paul Clarkson

PURPOSE: Diffuse-type Tenosynovial Giant-Cell Tumour (d-TGCT) of large joints is a rare, locally aggressive, soft tissue tumour affecting predominantly the knee. Previously classified as Pigmented Villonodular Synovitis (PVNS), this monoarticular disease arises from the synovial lining and is more common in younger adults. Given the diffuse and aggressive nature of this tumour, local control is often difficult and recurrence rates are high. Current literature is comprised primarily of small, and a few larger but heterogeneous, observational studies. Both arthroscopic and open synovectomy techniques, or combinations thereof, have been described for treatment of d-TGCT of the knee.

There is, however, no consensus on the best approach to minimize recurrence of d-TGCT of the knee. Some limited evidence would suggest that a staged, open anterior and posterior synovectomy might be of benefit in reducing recurrence. To our knowledge, no case series has specifically looked at the recurrence rate of d-TGCT of the knee following a staged, open, posterior and anterior approach. We hypothesized that this approach may provide better recurrence rates as suggested by larger more heterogenous series.

METHODS: A retrospective review of the local pathology database was performed to identify all cases of d-TGCT or PVNS of the knee treated surgically at our institution over the past 15 years. All cases were treated by a single fellowship-trained orthopaedic oncology surgeon, using a consistent, staged, open, posterior and anterior approach for synovectomy. All cases were confirmed by histopathology and followed-up with regular repeat MRI to monitor for recurrence. Medical records of these patients were reviewed to extract demographic information, as well as outcomes data, specifically recurrence rate and complications. Any adjuvant treatments or subsequent surgical interventions were noted.

RESULTS: 23 patients with a minimum follow up of 18 months were identified. Mean age was 36.3 at time of treatment. There were 10 females and 13 males. Mean follow up was 7.5 years. 14/23 (60.9%) had no previous treatment. 5/23 had a previous arthroscopic synovectomy, 1/23 had a previous combined anterior arthroscopic and posterior open synovectomy, and 3/23 had a previous open synovectomy. Mean time between stages was 87 days (2.9 months). 7/23 (30.4%) patients had a recurrence. Of these, 3/7 (42.9%) were treated with Imatinib and 4/7 (57.1%) were treated with repeat surgery (3/4 arthroscopic and 1/4 open).

CONCLUSIONS: Recurrence rates of diffuse type TGCT in the literature vary widely but tend to be high. In our retrospective study, a staged, open, anterior and posterior synovectomy provides recurrence rates that are lower than rates previously reported in the literature. These findings support prior data suggesting this approach may result in better rates of recurrence for this highly recurrent difficult to treat tumour.

1125-1135 Follow-up After ACL Reconstruction: How Long is Long Enough? – Dr. Alex Hoffer (R4)

Authors: **Hoffer**, Alex; Leith, Jordan
Supervisor: Dr. Jordan Leith

PURPOSE: Anterior cruciate ligament (ACL) injury is the most common athletic ligament injury. Over 130,000 ACL reconstructions (ACLR) are completed annually in the USA, costing over two billion dollars. The appropriate length of clinical follow-up after ACLR remains in question. Return to sport after ACLR is achieved by one year postoperatively and clinical outcome scores and performance may plateau at that time. Yet, academic literature continues to define short-term follow-up as two years after surgery. We sought to assess differences in clinical outcome scores at one- and two-years post ACLR and evaluate the need for follow-up past one-year after surgery.

METHODS: A retrospective comparison was made from prospectively collected patient-reported outcome scores since 2016 for a single cohort. Externally validated outcome scores included the Visual Analog Scale for pain (VAS), the Marx activity scale, the Knee Injury and Osteoarthritis Outcome Score (KOOS), the International Knee Documentation Committee (IKDC) subjective knee score and the Single Assessment Numeric Evaluation (SANE) knee score. Scores were collected through online surveys pre-operatively, at two-weeks, six-weeks, three-months, six-months, one-year and two-years post-operatively. Descriptive statistics and a repeated measures analysis of outcome scores at one- and two-years after surgery was carried out using SPSS. Differences in outcome scores were compared to previously published minimal detectable change (MDC) and/or minimally clinically important differences (MCID) for each score.

RESULTS: To date, 295 participant surveys have been returned for at least one time point. There was no difference in VAS scores between one ($M = 1.05$, $SD = 1.49$) and two ($M = 0.77$, $SD = 1.21$) years after surgery ($N = 119$, $p = 0.07$). The Marx activity scale was inferior at one ($M = 7.24$, $SD = 4.71$) compared to two ($M = 8.35$, $SD = 4.64$) years after surgery ($N = 119$, $p = 0.013$) but did not meet the previously reported MDC of 9.9 points. The KOOS symptom score was worse at one ($M = 79.59$, $SD = 13.71$) compared to two ($M = 84.39$, $SD = 11.33$) years after surgery ($N = 116$, $p < 0.001$) but did not meet the previously reported MDC range of 9.9-24.3 points. The IKDC-subjective score was inferior at one ($M = 77.07$, $SD = 13.47$) compared to two years ($M = 83.74$, $SD = 12.33$) after surgery ($N = 113$, $p < 0.001$) but did not meet the previously reported MDC range of 6.7-20.5 or MCID of 11.5. The SANE knee score was inferior at one ($M = 79.75$, $SD = 14.59$) compared to two years ($M = 85.88$, $SD = 12.39$) after surgery ($N = 116$, $p < 0.001$) but did not meet the previously reported MCID range of 11.8-27.25 points.

CONCLUSIONS: Patient-reported outcome scores may not meaningfully change between one and two years after ACLR. As re-injury generally triggers re-referral, a two-year surveillance follow-up visit has minimal clinical utility and increases financial and opportunity costs for both the patient and the physician.

1135-1145 ACL hamstring graft preparation: A modified technique to significantly reduce your time on the back table – Dr. Doug Kingwell (Clinical Fellow)

Author: **Kingwell**, Douglas
Supervisor: Dr. Jordan Leith

BACKGROUND: The preparation of ACL reconstruction grafts has evolved over the years. Factors such as graft choice, fixation methods and number of strands all play a role in how the graft is prepared. A quadrupled semitendinosus graft is a popular technique for ACL

reconstruction. We describe a variation in common graft preparation, using techniques from Australia and Canada and propose that this technique saves significant graft preparation time, cost and exposes more graft to the bone within the tunnel.

METHODS: Graft preparation times with the modified technique were measured and compared to the previously used technique. Cost of materials was analysed.

RESULTS: Graft preparation time with the new technique was reduced by almost a half.

DISCUSSION: This modified ACL preparation technique can significantly reduce graft preparation time and hence contribute to shorter operative and tourniquet times. Biomechanical testing in the literature suggests this technique doesn't compromise graft strength and may result in less suture material on the outside of the graft. This preparation method can be applied to hamstring ACL reconstructions performed using transtibial graft passage and potentially those with an all inside technique.

1145-1155 **Does Use of Navigation or Robotics Reduce TKA Revision Rates Enough to Justify Broad Adoption? A Simulation-Based Power Analysis – Matthew Hickey (Graduate Studies)**

Author: **Hickey, Matthew**

Supervisors: Dr. Anthony Hodgson, Dr. Bas Masri

Robotic and navigated TKA procedures have been introduced to improve component placement precision for the purpose of improving implant survivorship and other clinical outcomes. Although numerous comparative studies have shown enhanced precision and accuracy in placing components, many comparative studies have not shown that such interventions result in improved implant survival. The two main reasons for these outcomes are (1) that the effect of increased precision and accuracy on implant survival is low, or (2) that the published studies have insufficient power.

In this simulation study we aimed to answer the following questions (1) Can we determine the statistical power as a function of study design (number of patients and follow-up time) for clinical studies comparing revision rates in robotic/navigated (RA/NAV) versus conventional TKA?, and (2) are existing clinical studies too underpowered to detect differences in revision rates between RA/NAV and conventional TKA?

We conducted a simulation-based analysis with the goal of characterizing the impact of surgeon-controlled variables on implant survival and gaining insight on the study designs used to answer questions relating to implant failure. Using hypothesized effect sizes drawn from the literature, combined with estimates of the accuracy and precision of a variety of navigation and robotic systems, we modeled and simulated the likely outcomes of a range of potential comparative clinical study designs. To obtain estimated effect sizes, we conducted a systematic review of recently published literature evaluating the effect of robotics and navigation on revision rates compared to conventional TKA. Next, we generated a set of 1.5m simulated TKA patients randomly assigning each patient a set of patient-specific factors (age at index surgery, gender, body mass index) drawn from registry data and published literature. The set of simulated patients is divided into two groups representing coronal alignment precisions reported for manual ($\pm 3^\circ$) and technology assisted ($\pm 1.5^\circ$) TKA, and randomly assigned each patient an overall coronal alignment consistent with their group's precision. To evaluate the power associated with using different cohort sizes, we ran a Monte Carlo simulation generating 3,000 simulated populations drawn (with replacement) from the simulated TKA patients. We then simulated the time to failure for each patient, computed the corresponding Kaplan-Meier survival curves, and applied a Log-Rank test to each study to test for statistical difference at different follow-up times. From the 75,000

simulations associated with cohort sizes, we determined the percentage of simulated studies that found a statistically significant difference at each follow-up time.

The literature search yielded 83 results using several databases. In total, we found 17 papers that met all of our inclusion criteria, only one of which reported a statistically significant difference between conventional and RA/NAV groups. The results from our simulations showed that, for the estimated effect sizes reported in the literature, comparison studies would need to enroll between 4500 and 8000 total patients, depending on the precision of the navigated or robotic procedure, to have an 80% chance of showing a reduction in revision rates at 15 years follow-up. All the identified studies had cohort numbers that implied that they were significantly underpowered.

1155 – 1300 LUNCH

1300-1310 Does Pelvic Arterial Embolization Increase Surgical Site Infection in Trauma Patients Undergoing Pelvic Ring Fixation – Dr. Aresh Sepehri (R4)

Authors: **Sepehri**, Aresh; Lefavre, Kelly A; Guy, Pierre
Supervisor: Dr. Pierre Guy

PURPOSE: The rate of arterial injury in trauma patients with pelvic ring fractures has been cited as high as 15%. Addressing this source of hemorrhage is essential in the management of these patients as mortality rates are reported as 50%. Percutaneous techniques to control arterial bleeding, such as embolization and REBOA, are being employed with increasing frequency due to their assumed lower morbidity and invasiveness than open exploration or cross clamping of the aorta.

There are promising results with regards to the mortality benefits of angioembolization. However, there are concerns with regards to morbidity associated with embolization of the internal iliac vessels and its branches including surgical wound infection, gluteal muscle necrosis, nerve injury, bowel infarction, and thigh / buttock claudication.

The primary aim of this study is to determine whether pelvic arterial embolization is associated with surgical site infection (SSI) in trauma patients undergoing pelvic ring fixation.

METHODS: This observational cohort study was conducted using US trauma registry data from the American College of Surgeons (ACS) National Trauma Database for the year of 2018. Patients over the age of 18 who were transported through emergency health services to an ACS Level 1 or 2 trauma hospital and sustained a pelvic ring fracture treated with surgical fixation were included. Patients who were transferred between facilities, presented to the emergency department with no signs of life, presented with isolated penetrating trauma, and pregnant patients were excluded from the study.

The primary study outcome was surgical site infection. Multivariable logistic regression was performed to estimate treatment effects of angioembolization of pelvic vessels on surgical site infection, adjusting for known risk factors for infection.

RESULTS: Study analysis included 6562 trauma patients, of which 508 (7.7%) of patients underwent pelvic angioembolization. Overall, 148 (2.2%) of patients had a surgical site infection, with a higher risk (7.1%) in patients undergoing angioembolization (OR 4.05; 95% CI 2.75, 5.96; $p < 0.0001$). Controlling for potential confounding, pelvic angioembolization was still significantly associated with increased odds for surgical site infection (aOR 2.46; 95% CI 1.50, 4.01; $p = 0.0003$).

CONCLUSIONS: This study demonstrates that trauma patients who undergo pelvic angioembolization and operative fixation of pelvic ring injuries have a higher surgical site infection risk. As the use of percutaneous hemorrhage control techniques increase, it is important to remain judicious in patient selection.

1310-1320 **In Trauma Patients with Pelvic Ring Injuries, what factors are predictive of arterial pelvic hemorrhage requiring embolization and what are the associated complication rate of pelvic Embolization – Dr. Aly Alsaifan (R3)**

Authors: **Alsaifan**, Aly; Sepehri, Aresh
Supervisor: Dr. Pierre Guy

PURPOSE: The purpose of this study is to address the following questions, 1- In trauma patients with pelvic ring injuries, what factors are predictive of arterial pelvic hemorrhage requiring embolization, 2- What is the complication rate of pelvic embolization in trauma patients with pelvic ring fixation.

The impetus of this study is that we are using angiography and embolization more and more frequently. Two issues have arisen from this: firstly, not everyone who gets angiography requires embolization. This introduces the unnecessary risks with femoral artery access and delays other interventional care. In addition, embolization introduces risk such as infection and gluteal muscle necrosis, such as seen in non- selective internal iliac artery embolization

METHODS: Systematic review. Using pubmed, 2066 papers were identified with the key words of pelvic ring fracture, angiography, embolization, angio-embolization. All papers included needed to be English language, adult population > 18, have pelvic ring injuries, underwent angiography +/- embolization. Abstract screening performed identifying 299 full text reviews. The extracted information from these papers include, rate of patients who underwent angiography, and/or embolization and the rate of complications as reported.

RESULTS: TBD

CONCLUSIONS: TBD

1320-1330 **Outcomes in resuscitative endovascular balloon occlusion of the aorta (REBOA) in hemodynamically unstable patients with pelvic ring injuries: A systematic review – Dr. James Yan (Clinical Fellow)**

Authors: **Yan**, James; Sepehri, Aresh; Viskontas, Darius
Supervisor: Dr. Darius Viskontas

BACKGROUND: Hemorrhage is the most common cause of mortality in trauma patients with pelvic ring injuries. Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a relatively novel and minimally invasive intervention that can temporarily control hemorrhage through an endovascularly inflated balloon stent at the level of the great vessels. The aim of this systematic review is to assess the outcomes and complications following REBOA in hemodynamically unstable trauma patients with pelvic ring injuries.

METHODS: A systematic review was conducted reviewing articles published in the Embase, Medline, Web of Science, and Cochrane databases. Two independent reviewers screened available articles based off pre-set inclusion and exclusion criteria. Twelve studies that reported outcomes for REBOA in hemodynamically unstable trauma patients with pelvic ring fractures were included to data extraction.

RESULTS: Twelve studies representing 806 pelvic trauma patients requiring REBOA were found in this review. Ten were level IV studies and 2 were level III studies. The mean patient age was 46.9 years (range 22 - 79) and 70.5% of patients were male. The mean Injury Severity Score was 38 (range 28 - 48). Overall mortality reported was 53.9% across all 12 studies. Mortality within the first 24 hours of care was 42.5% among the studies that reported this. Mean time to REBOA, transfusions needed, and length of stay was 69.8 minutes, 16.5 units of packed red blood cells, and 35.3 days. There were only 4 studies that included comparative intervention which reported commonly on mortality, length of stay, and amount of transfusion. Complication rates were found to be 37.4%. The most common type of complication reported was acute kidney injury, amounting to 39.6% of reported complications.

CONCLUSION: REBOA can be a potential option for hemorrhage control in the high acuity complex trauma patient with pelvic ring injuries. However, its use is still linked to high mortality and complication rates. These issues may improve with further utilization and technical refinement. As with many emerging technologies, the amount and level of evidence available for the use of REBOA is still scarce. It requires technical proficiency and a centre with considerable resources and interdisciplinary teams which limits its adoption. Future directions should include more randomized controlled trials or multicentred studies, and standardized reporting outcomes in order to provide a clearer clinical picture of this procedure.

1330-1340 **What are the Optimal Targeting Visualizations for Performing Surgical Navigation of Iliosacral Screws? A Crossover Trial – Prashant Pandey (Graduate Studies)**

Authors: **Pandey**, Prashant U; Guy, Pierre; Lefavre, Kelly A; Hodgson, Antony J;
Supervisors: Dr. Anthony Hodgson, Dr. Pierre Guy

INTRODUCTION: Complex orthopaedic procedures, such as iliosacral screw (ISS) fixations, can take advantage of surgical navigation technology to achieve accurate results. Although the impact of surgical navigation on outcomes have been studied, no studies to date have quantified how the design of the targeting display used for navigation affects ISS targeting performance. However, it is known in other contexts that how task information is displayed can have significant effects on both accuracy and time required to perform motor tasks, and that this can be different among users with different experience levels.

METHODS: We conducted a crossover user study to investigate which visualization techniques helped experienced trauma surgeons and inexperienced users most effectively align a surgical tool to a target axis. We proposed five 2D visualizations (bullseye, rotated bullseye, target-fixed, tool-fixed in translation, and tool-fixed in translation and rotation) with varying representations of the ISS targets and tool, and one 3D visualization. We measured the targeting accuracy achieved by each participant, as well as the time required to perform the task using each of the visualizations.

RESULTS: We found that all 2D visualizations had equivalent translational and rotational errors, with mean translational errors below 0.9 mm and rotational errors below 1.1°. The 3D visualization had statistically greater mean translational and rotational errors (4.29 mm and 5.47°, $p < 0.001$) across all users. We also found that the 2D bullseye view allowed users to complete the simulated task most efficiently (mean: 30.2s; 95% CI: 26.4 – 35.7s), even when combined with other visualizations.

CONCLUSIONS: Our results show that 2D bullseye views helped both experienced orthopaedic trauma surgeons and inexperienced users target iliosacral screws accurately and efficiently. These findings could inform the design of visualizations for use in a surgical navigation system for screw insertions for both training and surgical practice.

1340-1350 **Nonmodular Tapered Fluted Titanium Stems Perform Reliably at Medium Term in Revision THR – Dr. Michael Nitikman (R4)**

Authors: **Nitikman**, Michael; Howard, Lisa; Masri, Bas; Garbuz, Donald
Supervisor: Dr. Lisa Howard

PURPOSE: The ideal femoral component for revision THA is undecided. Cylindrical nonmodular stems have been associated with stress shielding, whereas junctional fractures have been reported with tapered fluted modular titanium stems. The purpose of our study was to explore the medium-term outcomes using a tapered fluted nonmodular titanium femoral component (Wagner Self-locking [SL] femoral stem).

METHODS: Between May 2011 and December 2014, we performed 434 femoral revisions, of which 185 (42%) were performed using the Wagner SL femoral stem; during that period, our institution gradually shifted toward increasing use of these stems for all but the most severe revisions, in which modular fluted stems and proximal femoral replacements still are used on an occasional basis. Our inclusion criteria were: femoral revisions using the Wagner SL stem, minimum 2 years follow-up. All patients had radiographs performed within 1 year of the latest follow-up and were assessed for signs of proximal femoral bone remodeling and subsidence. We collected the following data: demographics, complications and re-revisions, Paprosky classification of the femur and functional outcomes (Oxford Hip Score (OHS), WOMAC, SF-12, and the University of California Los Angeles (UCLA) activity score.)

RESULTS: Median follow-up in this retrospective study was 7.25 years (range 4.5–9.4 years). 14 patients were lost to follow-up before the minimum and 50 patients were deceased. The femoral deformities in this series were Paprosky Type I (68 hips), Paprosky Type II (78), Paprosky Type IIIA (30), Paprosky Type IIIB (2), and Paprosky Type IV (3). Signs of maintenance or restoration of proximal femoral bone stock was noted in 127 of 171 hips (74%). 26 (26/171; 15%) patients had subsidence of at least 10 mm (range 10 – 30mm). In the remainder (145/171; 85%), the mean subsidence was 2.4 mm (range, 0–9 mm). 23 stems showed subsidence >10mm, but stabilized with either boney or fibrous ingrowth. One stem stabilized but had a clear radiolucent line, and two stems showed progressive subsidence and radiolucent lines at recent follow up. The re-revision rate was 15% (25/171). The indication for revision was instability (8/171; 4.7%), deep infection (5/171; 2.9%) acetabular loosening (4/171; 2.3%), periprosthetic fracture (2/171; 1.2%) and pseudotumor (1/171; 0.6%). The 5 and 8 year survivorship for all-cause revision was 88% (95% CI 82%, 92%) and 84% (95% CI 77%, 89%), respectively. The stem was revised in eight patients for infection (5/171; 2.9%) and periprosthetic fracture (3/171; 1.8%). No stems were revised for aseptic loosening.

CONCLUSIONS: The Wagner SL stem is a viable option for patients with Paprosky Types II and III defects undergoing revision THA. This component has low revision rates and low rates of subsidence in the medium term. They provide a viable alternative to modular components for treatment of Types II and III defects without the risk of junctional fractures. They can be used for very selected Type IV defects, however this extent of bone loss is most easily addressed with other techniques such as a proximal femoral replacement.

1350-1400 **Return to High Intensity Sport Following Hip and Knee Arthroplasty – Dr. Abdulmohsen Almeshari (R2)**

Authors: **Almeshari**, Abdulmohsen; Greidanus, Nelson
Supervisor: Dr. Nelson Greidanus

PURPOSE: Historically, the most common indication for lower limb joint reconstruction was pain relief and improvement of quality of life, mostly in the elderly population. However, with

newer implant designs, and increased component longevity, indications for such procedures expanded to include the younger, more active population. Those often demand a return to higher function level such as high intensity sport. Our primary objective is to evaluate and describe the return to high intensity sport in patients who had hip or knee arthroplasties. Our secondary objectives include assessing post-operative outcomes and any prosthetic related complications.

METHODS: This is a cross sectional study. A survey questionnaire will be distributed to patients who had their hip or knee arthroplasties within the last 10 years and who were below 70 years of age at the time of the surgery. The patients will be identified from the VGH ortho recon database. The questionnaire will include assessment of return to high intensity sport, any prosthetic related complications, and validated instruments to assess post-op outcome and activity level. Analysis will include both descriptive statistics as well as analyses to evaluate key determinants for return to sport specific high intensity activity.

HYPOTHESIS: Given the current state and implant techniques in hip and knee arthroplasties, we hypothesize that patients are able to return to performing high intensity sports without restrictions after their joint arthroplasties.

CONCLUSIONS: Pending

1400-1410 **A Novel Method for Observing Hip Fracture during Impact Simulating a Sideways Fall – Emily Bliven (Graduate Studies)**

Authors: **Bliven**, Emily K; Guy, Pierre; Helgason, B; Cripton, Peter
Supervisors: Dr. Peter Cripton, Dr. Pierre Guy

INTRODUCTION: Hip fracture is a devastating injury associated with high rates of morbidity and mortality. Understanding the biomechanics of how these fractures occur is essential for the advancement of successful treatment and prevention strategies. Bone surfaces are usually not visible during impact tests of biofidelic specimens (with soft tissue surrogate), prohibiting proper visualization of fracture occurrence. Our research aims to 1) identify optimal exposure factors and camera parameters for imaging bone through soft tissue surrogate, 2) establish system configuration to assess physical compatibility of the x-ray system and the fall simulator, and 3) investigate the feasibility of tracking metal beads and an orthopedic implant during a realistic sideways fall impact.

METHODS: We used a pendulum fall simulator previously developed in our lab and shown to successfully produce clinically relevant hip fracture patterns in inertia-driven impacts. In the present study, we supplemented this experimental set-up with a custom high-speed x-ray system consisting of an x-ray source, image intensifier, and high-speed video camera. Proof-of-concept methods included the optimization of the novel system by identifying parameters such as configuration, x-ray exposure factors, resolution, and capture rate. The feasibility of capturing fracture was tested with pilot fall tests using a surrogate femur-pelvis construct. Later trials investigated the potential for tracking metal beads and an orthopedic screw implanted in the proximal femur.

RESULTS: We were able successfully integrate the novel system as well as capture fracture propagation and other behavior. Metal beads could be tracked to displacements below 0.1 mm. The results of this pilot work demonstrate the ability to observe hip fracture using the high-speed x-ray system with the previously developed fall simulator.

CONCLUSIONS: Conclusion: The presented tool is theorized to offer more robust capabilities than current imaging techniques to observe bone mechanics during impact tests. Obtaining such data could be key to understanding and ultimately preventing hip fractures, particularly when an implant is present.

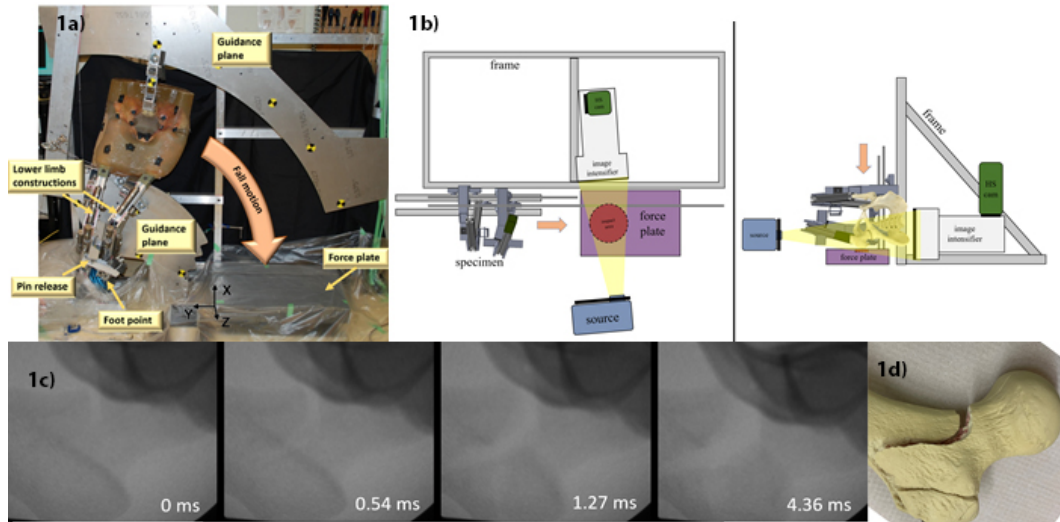


Fig 1 a) Fall Simulator testing apparatus; b) Integration of Image Intensifier in testing set-up; c) Sequential High Speed Radiographs (note notching); d) Post-test fractured Sawbones® femur model

1410-1420 **dGEMRIC T1 is Reduced in Cartilage Overlying Bone Marrow Lesions in the Hip – Carly Jones (Graduate Studies)**

Authors: **Jones** Carly; Cibere, Jolanda; Zhang, Honglin; Qian, Hong; Guo, Yimeng; Russell, David; Forster, Bruce; Wong, Hubert; Esdaile, John; Wilson, David
 Supervisor: Dr. David Wilson

PURPOSE: Bone marrow lesions (BML) are associated with painful and progressive OA. Quantitative MRI has found evidence of early cartilage degeneration overlying BMLs in knees, but similar work has not been done in the hip. The purpose of this study is to determine whether there is evidence of cartilage degeneration in BML overlying cartilage in hips.

METHODS: MRI study participants (n=128) were recruited from a cross-sectional population-based study of adults aged 20-49 years. Delayed Gadolinium Enhanced MRI of Cartilage (dGEMRIC) and proton-density weighted fat-suppressed (PDw-FS) MRI scans were acquired of one hip for each participant. dGEMRIC is a well-validated method of quantifying cartilage proteoglycan content using MRI. BMLs were identified from PDw-FS scans by a MSK radiologist, and only scans of hips with BMLs (n=32) were used in this study (age 44.4 (SD: 6.5), 62.5% F). BMLs were segmented semi-automatically from the PDw-FS scans, and acetabular and femoral cartilage were segmented manually from the dGEMRIC scans (Analyze 10 (AnalyzeDirect, KS)). The PDw-FS and dGEMRIC images were rigidly registered using landmark points to align the cartilage with the BML locations. Outlines of BMLs were projected onto the hip cartilage either radially outwards from (femoral BMLs) or towards (acetabular BMLs) the centre of the femoral head to define the BML overlying cartilage. Mean T1Gd was calculated for the BML overlying cartilage (OC) and the surrounding cartilage (SC) for the full cartilage thickness (all BMLs), acetabular cartilage (acetabular BMLs), and femoral cartilage (femoral BMLs). We tested the statistical hypotheses that mean T1Gd of OC was different from mean T1Gd of SC using a paired t-test in MATLAB (Mathworks, MA).

RESULTS: For the combined hip cartilage, mean T1Gd was 59ms (SD: 165ms) lower in overlying cartilage than surrounding cartilage ($p=0.05$, $n=32$). For acetabular cartilage, mean T1Gd was 45ms (SD: 109ms) lower in overlying cartilage than surrounding cartilage ($p=0.06$, $n=23$). For femoral cartilage, mean T1Gd was 117ms (SD: 193ms) lower in overlying cartilage than surrounding cartilage ($p=0.03$, $n=15$).

CONCLUSIONS: Our result that mean T1Gd is lower in hip OC than SC suggests that hip OC has a lower proteoglycan content than hip SC, which is consistent with previous research of BMLs in the knee. We found the largest difference in mean T1Gd between OC and SC in the femoral cartilage. These preliminary results suggest that BML overlying cartilage in the hip has a lower proteoglycan content than the surrounding cartilage.

1420-1430 **Digitally reconstructed radiographs to evaluate the effect of patient position on hip migration percentage – Luke Johnson (Graduate Studies)**

Authors: **Johnson**, Luke; Miller, Stacey; Rosenbaum, Daniel; Wilson, David; Mulpuri, Kishore

Supervisors: Dr. Kishore Mulpuri, Dr. David Wilson

PURPOSE: Children with cerebral palsy (CP) are at risk of progressive hip displacement. Hip surveillance, which includes radiographs in standardized positioning, is the standard of care to allow for early identification of displacement. However, children may be unable to assume this position due to muscle contractures and tone. It is unclear how patient positioning impacts migration percentage (MP), a common clinical measure of hip displacement. Previous research has been limited by a lack of methods to compare multiple postures in a repeatable manner without excessive radiation dose.

This proof-of-concept pilot study had two objectives:

- 1) To develop a method of generating simulated clinical radiographs of the hip in different postures using CT data and digitally reconstructed radiographs (DRRs).
- 2) To use DRRs to determine whether internal rotation (IR) and external rotation (ER) of the hip affects MP measurement in normal adult hips.

We tested the hypothesis: IR and ER of the hip will affect MP values.

METHODS: Post-mortem CT data of normal adult hips were obtained from the New Mexico Decedent Image Database. 395 database entries fulfilled the inclusion criteria (age 25-50 years, medical history of broken bones). Five subjects (ten hips) were randomly selected from the eligible entries. The selection ($n=3$ male) had a mean age of 33 years, 9 months (SD 9 years, 11 months).

Both femurs and the pelvis were segmented with 3D Slicer. In-house MATLAB code was then used to define a joint coordinate system for each hip, perform joint rotations on the CT data, and generate DRRs with the hip in 7 positions (3 in IR, 3 in ER, and one neutral). Two raters measured MP from these DRRs.

RESULTS: We observed good Inter-rater reliability for measurement of MP ($r=0.907$, $ICC=0.808$). Significant changes in MP ($p<0.05$) occurred at -20° , -10° , 20° and 30° IR relative to neutral positioning. The largest changes in MP were seen at 20° IR (mean change -1.54% , 95% CI -2.23% , -0.84%) and 30° IR (-1.48 , 95% CI -2.71 , -0.25).

CONCLUSIONS: While rotation of the hip on reconstructed radiographs affected MP significantly, these effects were smaller than the expected accuracy in a clinical setting (at least 5% for experienced radiologists). The clinical implications of rotation on this population of normal adult hips was, therefore, limited. This study demonstrates a versatile tool to create simulated clinical radiographs of the hip for clinical research. Future research will validate this technique in pathologic hips in children with CP and other hip conditions.

1430-1440 **Unreamed Intramedullary Nailing versus External Fixation for the Treatment of Open Tibial Shaft Fractures in Uganda: A Randomized Clinical Trial – Dr. David Stockton (R5)**

Authors: **Stockton**, David; Kyengera, Daniel; O'Hara, Nathan; Slobogean, Gerard; Howe, Andrea; Blachut, Piotr; O'Brien, Peter
Supervisor: Dr. Peter J O'Brien

BACKGROUND: In low-income countries, external fixation is often the standard of care for the definitive treatment of open tibial shaft fractures. This is in contrast to high-income countries where the standard is intramedullary nailing. We performed a parallel group, randomized clinical trial at a regional hospital in Uganda to compare unreamed intramedullary nailing versus external fixation for the treatment of open tibial shaft fractures.

METHODS: We screened all skeletally mature patients presenting with open tibial shaft fractures to the study location. Patients were included if they presented with Gustilo-Anderson Type II or IIIA open tibial shaft fracture and received definitive treatment within 24 hours. Our primary outcome was the Function Index for Trauma (FIX-IT), measured at 6 weeks, 3 months, 6 months, and 12 months after randomization. Secondary outcomes included quality of life (EQ-5D-3L), radiographic healing (RUST score), malunion, nonunion, and deep surgical site infection. We calculated treatment effects using Bayesian models informed by prior meta-analysis data which suggests a medium treatment benefit with intramedullary nailing. We report the probability of any (>0) treatment benefit for intramedullary nailing, and the probability of treatment benefits exceeding minimal clinically important thresholds.

RESULTS: The trial enrolled 54 patients (n=31 to intramedullary nailing and n=24 to external fixation) with a mean age of 39 years (SD: 12), and 65% were male. There was a >99% probability of an improved FIX-IT score with intramedullary nailing compared with external fixation (difference, 1.4-points, 95% CI, 0.7 to 2.1). However, there was only a 38% chance the treatment benefit of intramedullary nailing would exceed a minimal clinically important difference of 1.5-points. Similarly, our analysis indicated a higher probability of improved outcomes with intramedullary nailing treatment with respect to quality of life (96%), malunion (99%), nonunion (84%), and deep infection (51%). Although, with the exception of a reduced risk of malunion (73%) and nonunion (50%), it is unlikely that intramedullary nailing treatment benefits would exceed minimal clinically important differences for quality of life (45%) and deep infection (30%).

DISCUSSION: Our findings suggest that intramedullary nailing has broad treatment benefits compared with external fixation for the treatment of open tibial shaft fractures in low-resource settings. However, it is unlikely that these treatment benefits exceed minimal clinically important differences for many patient-important outcomes, such as function, quality of life, and deep infection.

1440 – 1450 REFRESHMENT BREAK

1450-1500 **Health Related Quality of Life in Children with Fibular Hemimelia – Dr. Njalalle Baraza (Clinical Fellow)**

Authors: **Baraza**, Njalalle; Chhina, Harpreet; Panchal, Maitri; Irvine, Mike; Cooper, Anthony
Supervisor: Dr. Anthony Cooper

PURPOSE: Fibular hemimelia (FH) is a musculoskeletal disorder characterised by a lower limb failure of longitudinal formation. The aim of our study was to assess the health related quality of life (HRQL) of patients with FH at our centre.

METHODS: A prospective longitudinal study collected clinical, functional and HRQL outcomes in patients with limb deformities since 2015. HRQL data was collected using the Pediatric Quality of Life Inventory 4.0 Generic Core Scales (PedsQL).

RESULTS: Thirty patients with FH were identified. Out of these 30 patients, two were Paley type I, 10 type II, 13 type III, three type IV and two we were not able to classify as they had had amputations prior to presentation. The mean age of the patients at first presentation was 6.75 years (range 0 - 16 years). Median age of patients in the database was 11 for those who completed child scores and 11 for the parent proxy scores. Child self-reported PedsQL total score for normative (non-affected) population is known to be 82.87 with a minimally clinically important difference (MCID) of 4.36. For parent proxy reports of PedsQL, the score for the normative population is 81.34 with a MCID of 4.5. In total 114 HRQL scores, both parent and child, were collected. The median score was 82.0 [67.0 - 88.7]. The median child reported raw score was 87.0 and median parent proxy score was 75.5. The normalised score, obtained from subtracting the raw score from the score of the non-affected population and dividing it by the MCID, was 0.94 for the child reported scores and -1.29 for the parent proxy scores. The median months post surgery was 7.5 and 7 respectively for child and parent scores. The median number of procedures done was 2 (range 2-10).

The number of operations and the time since operation did not have a statistical effect on the normalised score, but in the child reports there was a trend towards improved outcomes with a higher number of operations, and the general trend in raw proxy scores reported by parents showed a rise as time progressed. There was a statistically significant difference in normalised scores between patients who had external fixator lengthening frames and those who did not when reported by the parents.

CONCLUSIONS: Fibula hemimelia has a negative impact on the HRQL of children as reported by parents, but in child reported scores there is no statistically significant difference compared to the non-affected population. Targeted operative treatment shows a trend towards improvement in the child reported scores, and parents reported lower scores in the presence of an external fixator frame.

1500-1510 **Sex differences in spatiotemporal gait parameters of transtibial amputees – Tess Carswell (Graduate Studies)**

Authors: **Carswell, Tess**
Supervisor: Dr. Joshua W Giles

BACKGROUND: Lower limb amputees are at risk for various comorbidities and gait analysis is commonly used to evaluate this risk and assess prosthetic design elements. This research often focuses on a predominantly male-subject base, despite female lower limb amputees having different risk factors and lower success with their prosthetics overall. It is widely agreed that sex differences exist in able-bodied gait, but research analyzing sex differences in lower limb amputee gait is rare.

OBJECTIVES: To compare male and female transtibial amputee gait parameters and ascertain potential sex differences.

METHODS: Forty-five transtibial amputees (35 men, 10 women) were asked to walk at their self-selected speed for 10 walking trials. Spatiotemporal gait data were obtained and both the mean and variability metric of parameters were analyzed.

RESULTS: For both sexes, the amputated limb had a shorter stance time, longer swing time, and larger step length compared to their intact limb. Also, females had a shorter stance time, step time, and a higher gait and stride velocity than males. Finally, various significant interactions were found in variability metrics of stride velocity, stance time, and step time, indicating greater variability in women.

CONCLUSIONS: Sex differences do exist in transtibial amputee gait. The differences in gait velocity and variability offer possible explanations for the different comorbidities experienced by female lower limb amputees.

CLINICAL RELEVANCE: Sex differences found in gait velocity and variability offer possible explanations for the different comorbidities experienced by female lower limb amputees. These results may have major implications for the quality of life of female lower limb amputees and for sex-specific research, rehabilitation, and prosthetic design in general.

1510-1520 **Cost Analysis and outcome differences for staged vs non-staged pes planovalgus foot reconstruction – Dr. John Steyn (R3)**

Authors: **Steyn**, John; Lowe, Danielle; Wing, Kevin; Younger, Alastair; Penner, Murray Veljkovic, Andrea
Supervisor: Dr. Andrea Veljkovic

Pes planovalgus foot reconstruction (PPFR) is complex and consists of multiple procedures. The exact procedures done are variable, depending on the characteristics of the deformity, as well as surgeon preference. In addition to the nuances of the procedure, the operation can be performed in a staged (S) or non-staged (NS) fashion. This is particularly interesting from a cost-analysis perspective. Furthermore, it begs the question of whether or not staging the procedures leads to outcome differences. Two surgeons in our group perform S and NS procedures respectively, providing the opportunity to assess the differences between these two strategies. We set out to determine cost difference with respect to time spent in hospital and OR time for S versus NS PPFR. Second, we assessed complications via chart review, as well as patient reported outcomes. Patients who underwent PPFR were identified via billing codes, and costs are currently in the analysis stage. Patient charts were reviewed, and an FAOS and PCS scale will be sent out, before finalizing the reported differences in the two strategies. Patients who underwent a NS procedure had a 4-night average hospital stay, while those undergoing a S procedure were discharged the same day. So far 22 S-patients and 32 NS- patients have been assessed. There was no significant difference in smoking, gender distribution, diabetes, or rheumatoid arthritis between the two groups, but there was a significant average age difference at 46 years in the S group and 56years in the NS group ($p= 0.01$). Overall-infection rate was not significantly different (9% in the S group vs 25% in the NS group $p=0.14$). Minor infection rates were similar between groups (9% NS vs 6% S, $p=0.68$) However, major infections were higher in the NS group (19% vs 0% $p=0.01$). In conclusion, there is a potentially higher major infection rate in the longer NS procedures compared to S, however with only 50% of patients analyzed thus far, the differences may still prove to be non-significant. We project that S procedures will be more cost-effective than NS, but we expect outcomes to be similar between the two groups. There is still a patient survey pending and more patients to be reviewed. Ultimately, we hope to identify which patients are best suited to the two different PPFR strategies and create an algorithm to aid decision making for PPFR.

1520-1530 **Levels of Evidence for Joint-Preserving Surgeries in Ankle Osteoarthritis: 2021 Update – Dr. Tanya MacDonell (R2)**

Authors: **MacDonell, T**; Peters, M; Younger, A; Salat, P; Penner, M; Wing, K; Veljkovic, A
Supervisor: Dr. Andrea Veljkovic

PURPOSE: To review the existing literature and determine the Level of Evidence (LoE) for joint-preserving surgical techniques used in ankle osteoarthritis, and to provide a grade of recommendation for each.

METHODS: A comprehensive literature review using the Embase and Medline databases was performed, encompassing articles from database inception to April 2021. Abstracts were reviewed to isolate literature with clinical outcomes that examined results of joint-preserving surgeries for ankle osteoarthritis. One hundred twenty-six articles met inclusion criteria. These were assigned a classification (I-V) of Level of Evidence by a minimum of two independent reviewers. The literature specific to the surgical techniques was then further analysed to assign a grade of recommendation to each technique.

RESULTS: As of April 2021, joint distraction arthroplasty remains supported by only poor-quality evidence (grade C). There is poor-quality (grade C) evidence against the isolated use of ankle arthroscopy in the surgical treatment of ankle osteoarthritis. There is fair-quality evidence (grade B) to support distal tibial osteotomy for ankle osteoarthritis prior to end-stage disease. Lastly, there remains insufficient evidence to support or refute the benefit of calcaneal osteotomy in the setting of ankle osteoarthritis (grade I).

CONCLUSIONS: There is improving evidence to support the role of distal tibial osteotomy in the surgical management of ankle osteoarthritis. Further high-quality studies are required to inform recommendations for the use of joint-sparing surgical techniques in ankle osteoarthritis.

1530-1540 **Catastrophic Polyethylene Failure in the Scandinavian Total Ankle Replacement (STAR): An Analysis of Patient and Implant-related Factors – Dr. Paul Kulyk (Clinical Fellow)**

Authors: **Kulyk, Paul**
Supervisor: Dr. Murray Penner

PURPOSE: The Scandinavian Total Ankle Replacement (STAR) has been one of the most commonly used ankle replacements in the world. Use of the STAR has been increasing in the USA since FDA approval in 2009. In other countries with longer STAR experience, its use has declined substantially. A 2011 study identified an 18% rate of polyethylene (PE) bearing fracture. Potential contributors to the decline in use include concerns regarding catastrophic failure of the PE. This study aims to identify clinical factors that contribute to PE bearing failure.

METHODS: A retrospective analysis was performed on prospectively collected data from a consecutive cohort of all STAR procedures at two major teaching hospitals in Canada between 2001 and 2005. All cases that had experienced catastrophic PE failure were identified, which comprised the study group. The control group was comprised of all cases where PE failure did not occur.

Patient-related factors included demographics, radiographic characteristics, and outcome measure scores. Implant-related factors included component size, and PE bearing thickness and shelf age. The Ankle Osteoarthritis Scale score was chosen as a surrogate measure of activity level. Weightbearing radiographs were obtained for all cases.

All PE bearings were inspected visually at the time of revision. Some were submitted for engineering analysis and scanning electron microscopy.

Patient characteristics were summarized for the two groups. A survival analysis was performed for the time to PE failure. The effect of individual patient and implant risk factors on PE failure was examined.

RESULTS: In the initial analysis of the 102 STAR cases that met inclusion criteria, 16 (15.7%) experienced PE bearing fracture. Four patients (3.9%) underwent PE revision for wear or osteolysis and were assigned to the control group with the 82 implants that were still intact (n=86).

Analysis on the several recent additional failures in the cohort is in progress.

CONCLUSIONS: PE fracture in the STAR likely occurs by exceeding the designed fatigue capacity of the bearing with factors that contribute to increased peak loads within the ankle or increased total loading cycles. The excessive stresses likely result from greater patient size and weight, high patient activity level, and preoperative ankle malalignment.

1540-1550 **Bony Ankle Impingement: Does SPECT scan uptake correlate with location and severity of pain? – Dr. Charlotte Allen (Clinical Fellow)**

Authors: **Allen**, Charlotte; Cardoso, Diogo; Penner, Murray; Wing, Kevin; Leith, Jordan; Younger, Alastair; Veljkovic, Andrea
Supervisor: Dr. Andrea Veljkovic

PURPOSE: There has been little published about anterior ankle bony impingement diagnosis and management. The key to its treatment is accurately assessing the location of impingement in order to guide surgical management.

SPECT scans are used commonly in investigation and diagnosis of foot and ankle conditions. There is minimal evidence surrounding the correlation of uptake and patient pain severity.

We wanted to use the SPECT scan as a tool that can match uptake to identify pain location and severity. This would help guide treatment and inform on severity of pain prior to surgery.

METHODS: All patients treated for bony ankle impingement between 2015-2019. Patients were included if they had undergone a pre-operative SPECT scan. Clinical notes were assessed to look at location and severity of pain. Pain was measured in VAS score which were then divided into 4 categories (0, 1-3, 4-6, 7-10). The SPECT scans were reviewed and categorised into 4 groups according to colour intensity (cold, mild, moderate, severe)

RESULTS: 69 patients were identified as having a diagnosis of anterior ankle impingement with a SPECT scan in their pre-operative work up between 2015 and 2019. We found a significant correlation between pain severity & SPECT uptake in patients with anterior ankle impingement. When subdivided based on location (medial and lateral) there was still significance shown.

CONCLUSIONS: Severity of pain correlates with SPECT scan signal and the location of impingement and pain is well defined

1550-1600 **Association of alignment and anterior ankle impingement – Dr. Diogo Cardoso (Clinical Fellow)**

Authors: **Cardoso**, Diogo Vieira; Leucht, Anna-Kathrin; Younger, Alastair, Wing, Kevin; Penner, Murray; Veljkovic, Andrea
Supervisor: Dr. Andrea Veljkovic

INTRODUCTION: Anterior ankle impingement is a common condition characterized by anterior ankle pain during ankle dorsiflexion, and it is mainly caused by bone or soft tissues interposition between tibia and talus. Anterior ankle impingement is normally classified into anteromedial and anterolateral according to location of impingement. To the best of our knowledge, no studies have assessed the role of ankle alignment in the type of ankle impingement. We hypothesize that the patient's alignment will influence the type of impingement, pain location and pain severity.

METHODS: All patients with anterior ankle impingement treated operatively between 2015 and 2019 were reviewed. Patients were grouped in anteromedial and anterolateral impingement according to pain location. Ankle radiographs were assessed for medial distal tibial angle (mDTA), talar tilt angle (TTA), Meary's angle, arch height, and hindfoot alignment. Pain was classified according to its medial and lateral location, and pain severity was assessed using VAS score.

RESULTS: 96 patients were treated, 55 (57%) were male. Mean age was 40 ± 13.6 years old. According to location of impingement, 74 (77%) were anteromedial and 22 (23%) anterolateral. Significant differences were observed for mDTA (mean $91 \pm 3^\circ$ in AL group vs $88 \pm 4^\circ$ in AM group, $p < 0.013$), TTA (mean $1.4 \pm 2.9^\circ$ in AL group vs $-2.3 \pm 5.3^\circ$ in AM group, $p < 0.002$), hindfoot alignment (mean 5.6 ± 10 mm in AL group vs -4.9 ± 13 mm in AM group, $p < 0.001$), arch height (mean 8.7 ± 6 mm in AL group vs 12 ± 7 mm in AM group, $p < 0.024$). According to the VAS score, anteromedial pain more than six was associated with hindfoot varus ($p < 0.008$), and anterolateral pain more than six with hindfoot valgus ($p < 0.003$), and distal tibial valgus ($p < 0.011$).

CONCLUSIONS: Our results show significant differences in ankle alignment between types of impingement. Anteromedial impingement was associated with more distal tibia varus, varus talar tilt and varus hindfoot. Anterolateral impingement was associated with more distal tibial valgus, valgus talar tilt and hindfoot valgus. Moreover, increased anteromedial and anterolateral pain was associated with hindfoot varus and valgus, respectively, suggesting that more hindfoot malalignment is associated with more severe ankle pain.

1600-1610 **Biomechanical Properties of Paraspinal Muscles in Adult Spinal Deformity Patients – A Preliminary Analysis - Masoud Malakoutian (Graduate Studies)**

Authors: **Malakoutian**, Masoud; Dehghan-Hamani, Iraj; Brown, Stephen H M; Doroudi, Majid; Schutz, Peter, Ailon, Tamir; Street, John; Oxland, Thomas R
Supervisor: Dr. Thomas R. Oxland

PURPOSE: Decreased back extensor strength in adult spinal deformity (ASD) patients is well established. While smaller muscle cross-sectional areas have been noted for ASD patients, whether other muscle biomechanical properties including passive elastic modulus and in situ sarcomere length (measured inside the body for a certain posture) in these patients leads to decreased strength remains unclear. A reason for lack of data on these paraspinal muscle properties is likely the ethical and technical challenges associated with acquiring fresh muscle biopsies from these patients. The objectives of this study were therefore, (1) to develop a procedure for acquisition of required human paraspinal muscle biopsies and (2) to evaluate their biomechanical and histological properties for ASD patients.

METHODS: Nine degenerative spine patients were recruited and categorized into group 1 (four patients) with no sagittal imbalance (SI) and no usage of compensatory mechanisms (CMs); group 2 (three patients) with no SI through usage of CMs; and group 3 (two patients) with SI despite usage of CMs. From each patient, 8 biopsies were collected at the L4-L5 level from right and left multifidus and longissimus: four biopsies (Type A) were taken with a specialized clamp for measurement of in situ sarcomere length, and the other four biopsies (Type B) were acquired through blunt cut and divided into two halves, one half for mechanical testing and the other half to be snap frozen for histology. Three single fibers and six fiber bundles were extracted from each biopsy and tested mechanically. The mechanical test involved the application of cumulative stretches of 10% strain increments followed by 4 minutes relaxation. The elastic modulus was calculated as tangent at 30% strain of the resulting stress-strain curve.

RESULTS: The average in situ sarcomere length for each patient ranged between 1.94 μm to 3.39 μm for multifidus and 1.99 μm to 3.11 μm for longissimus. For elastic modulus at the single fiber level, the medians for all groups fell between 27 to 37 kPa (except for group 3 longissimus, which was 13 kPa), while at the bundle level, the medians ranged between 46-113 kPa for multifidus and 38-102 kPa for longissimus. Thirty-seven from 171 tested bundles (22%) in this study exhibited larger stiffnesses than 120 kPa (an approximate threshold for outliers based on the only other study in the literature). In some cases, stiff bundles up to above 2000 kPa were measured. Histology revealed prevalence of fibrofatty component with a variety of case-specific abnormalities in mitochondrial function. In general, the degree of abnormality was more severe in patients of group II and III.

DISCUSSION: In situ sarcomere lengths showed large variations; several fiber bundles exhibited substantially high stiffnesses, and histopathological analysis revealed a variety of extracellular and intracellular case-specific abnormalities. No statistical comparison between the three patient groups could be made as patient recruitment halted due to COVID-19 and limited the number of patients in this study. From histopathology, finding a variety of cellular and extracellular abnormalities was suggestive of diverse causes or mechanisms of potential functional impairment. Through biomechanical assessment, the large variations observed for in situ sarcomere length and elastic modulus were suggestive of dramatic influences on muscle forces and spinal loading. The outcome of this study may serve as an invaluable input to musculoskeletal models to help in exploring the etiology of adult spinal deformity or assist in coming up with better treatment strategies for patients suffering from adult spinal deformity.

1610-1620 **Soft tissue procedures as treatment for planovalgus deformity – Dr. Dynai Ellig (Clinical Fellow)**

Authors: **Ellig**, Dynai; Veljkovic, A; Penner, M; Wing, K; Younger, A
Supervisor: Dr. Andrea Veljkovic

PURPOSE: Pes planovalgus is one of the most common progressive foot and ankle deformities and presents with wide range of severity and symptoms. Surgery is mostly indicated for significant malalignment, resistant to non-surgical management.

In the adult population PTTD is by far the most common cause of acquired pathological flatfoot deformity. Numerous surgical treatments are offered to treat the deformity in its different stages. Usually, it is either bony repair and a combined bony and soft tissue corrective surgery. Very little is written about the efficacy of “stand alone” soft tissue correction.

HYPOTHESIS: We expect to find:

1. Planovalgus deformity corrected after soft tissue procedures alone, seen on series of WB x ray imaging.
2. Patient’s subjective satisfaction increased.

Questions:

1. Improved in PVD to what extent?

METHODS:

- St. Paul’s based surgeries - Single Academic Institution
- Single surgeon – Andrea Veljkovic MD
- prospectively Collected Data
- 582 patients
- Years
- Review x ray images
- Standing AP + LAT foot and ankle, hindfoot alignment.
- Two fellowship trained Foot and Ankle surgeons review x rays.

MEASUREMENT:

- Preop, 6 W postop, 3 M postop, 6 M postop, 1 Y postop.
- XR – standing AP+LAT foot and ankle, and hindfoot alingement.
- Meary’s angle.
- Arch hight.
- Hidfoot alingement.
- VAS and % improvement.

EXCLUSION CRITERIA:

- No gastrocnemius recession or peroneus bravis to longus transfer.
- Midfoot or hindfoot procedures.
- Multiple procedures.
- Charcot foot or diabetic foot.
- No planovalgus deformity.
- Lost to follow up

RESULTS: Results Pending

1620 – 1630 Review Team Closing Comments

1630 ADJOURN
