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UGME FALL RESEARCH FORUM

November 24, 2022 | 2:00 PM – 4:00 PM PST

THURSDAY, NOVEMBER 24, 2022

Chair: Dr. Lise Leveille

Review Panel: Harpreet Chhina, Ashlee Dobbe, Eryck Moskven

Note:

1. All presentations are strictly limited to **5 minutes**, followed by a **5-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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1400 – 1405:

Welcome and Opening remarks – Dr. Lise Leveille

Research Presentations (5 min. presentation + 5 min. discussion)

1405 – 1415:

Charlene Harasym - *Measuring cartilage strain using MRI: a cross-validation sub-study*
(Dr. David Wilson)

1415 – 1425:

Michael Frew - *3D-Printed foot prosthesis for children with fibular hemimelia* (Sima Zakani)

1425 – 1435:

Mina Han - *Physician burnout and wellness in North American orthopaedic surgeons: A systematic review*
(Dr. A. Cooper)

1435 – 1445:

Noopur Ranganathan - *Identification of clinical and radiological indications for surgical treatment of genu valgum: a systematic review* (Dr. A. Cooper)

1445 – 1455:

Taewoong Chae, - *Application of virtual reality, augmented reality, and mixed reality in musculoskeletal undergraduate medical education: a scoping review.* (Dr. Lise Leveille)

1455 – 1505:

Sana Arora - *Safety and Efficacy of Elongated Screws for the Treatment of SCFE; a Prospective Observational Cohort* (Dr. Emily Schaeffer)

1505 – 1515:

Break



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1515 – 1525:

Tarini Boparai - *Mapping the landscape of Global Orthopaedics: A Scoping Review*
(Dr. Emily K Schaeffer)

1525 – 1535:

Trevor Fowler - *Ultrasound Screening for Infants at-risk of Developmental Hip Dysplasia in BC: Assessing Access-to-Care* (Dr. Kishore Mulpuri, Dr. Emily K Schaeffer)

1535 – 1545:

Sheila Lam - *Hip Displacement in Children with Leukodystrophies: a case series* (Dr. Stacey Miller & Dr. Maria Juricic)

1545-1555:

Review Team Closing Comments

1555: Adjourn

UGME Fall Research Forum Abstracts

14:05-14:15

Measuring cartilage strain using MRI: a cross-validation sub-study

Authors: **Harasym**, Charlene; Sullivan, Emily; Kupper, Jessica; Yung, Andrew
Supervisor: Dr. David Wilson

PURPOSE/HYPOTHESIS

Osteoarthritis (OA) is a debilitating disease that impacts joints such as the knee and hip via degeneration of the articular cartilage and the underlying bone. Abnormal joint mechanics and cartilage strain have been associated with OA. Magnetic resonance imaging (MRI) is a non-invasive method of assessing cartilage mechanics, which may help to improve the prevention and treatment of OA.

MRI sequences such as T2 and T1 ρ have been used to assess cartilage mechanics. However, these measures have a depth-dependent response to loading, which clinical MRIs cannot observe due to lower image resolution. The magnetization transfer ratio (MTR) is another MRI method that has potential for use in a lower resolution clinical scanner, but there are no studies that compare MTR's ability to measure cartilage strain to that of T2 and T1 ρ . To validate the sensitivity of MTR to cartilage compression, the strain of the cartilage needs to be measured from morphological MRI scans.

The objective of this sub-study is to validate the cartilage thickness measurements obtained from MRI scans, which are used to calculate cartilage strain. This will be done by comparing the MRI cartilage thickness measurements to cartilage thickness measurements found through previously validated contrast enhanced CT (CECT). We hypothesize that the error in cartilage thickness measurements between the two imaging modalities will be on the order of 0.1 mm, corresponding to a 5% error in cartilage strain for a 2 mm thick cartilage.

METHODS

Cartilage samples from the lateral femoral and tibial articulations of the knee were collected from three bovine specimens. These samples were imaged in a 9.4 Tesla MRI scanner (Bruker Biospec 94/30 USR) while unloaded and submerged in phosphate-buffered saline. The samples were then soaked in CA4+ contrast agent for 64 hours before being imaged in the unloaded state in a high-resolution peripheral quantitative computed tomography (HR-pQCT) scanner. Further work will be conducted to complete analysis between the two image sets: CT and MRI images will be registered and resampled to have the same pixel dimensions, and the cartilage will be manually segmented in each slice. Thicknesses of each column of segmented pixels will be calculated in both the MRI and CT images for each sample. Corresponding pixel columns between image sets will be directly compared via coefficients of variation, paired t-tests, and Bland-Altman analyses.

RESULTS

N/A

CONCLUSIONS

This study will establish the accuracy of measuring cartilage strain from MRI images. This is an essential step for developing new methods to measure cartilage strain both ex vivo and in vivo with the aim of improving OA treatment and prevention methodologies.

14:15-14:25

3D-Printed foot prosthesis for children with fibular hemimelia

Authors: **Frew** Michael, Emily Dunnion, Misha Hasan, Keith O'Connor, John Jacob, Tim Bhatnagar, Harpreet Chhina, Anthony Cooper
Supervisor: Sima Zakani

PURPOSE

Reconstruction surgeries mitigate leg length discrepancies, angular deformities and ankle instability, improving the child's overall mobility and independence. However, children with fibular hemimelia (FH) still struggle finding suitable footwear to accommodate foot size and shape differences and suffer from decreased stability, increased risk of tripping, and teasing from siblings and friends. This can impact their self-esteem and can discourage participation in physical and social activities. Here, we aimed to design and manufacture a patient-specific prosthesis to help improve function of the affected foot and reduce the economic burden of buying different sized shoes.

METHODS

Twenty-five children with FH from the Limb Reconstruction Clinic were invited to complete an in-house needs assessment survey, providing an understanding of their satisfaction (functional and comfort) with their current shoe and their footwear needs. Five children with a foot size discrepancy were invited to participate in the pilot study. Children's baseline needs and functional status were captured in four steps: (i) the needs assessment survey; (ii) Pediatric outcomes data collection instrument (PODCI); (iii) baseline gait; (iv) The Bruininks-Oseretsky Test of Motor Proficiency (Second Edition).

An anatomically accurate three-dimensional (3D) model of the participants' feet was created using a 3D surface scanner in different load-bearing scenarios. Each prosthesis was designed by complementing the surface anatomy of the affected foot with that of the unaffected foot, following guidelines available in the literature and in consultation with an occupational therapist and an orthopedic surgeon. Each prosthesis was 3D-printed using a combination of materials with shore hardness 70. The participants completed a follow-up satisfaction survey, the Bruininks-Oseretsky Test of Motor Proficiency and a detailed gait analysis within a three-month window of when they received the devices.

RESULTS

Results from the satisfaction survey showed an improvement in the needs identified in the needs assessment, suggesting the prosthesis was well received by the participants and found to be comfortable. The satisfaction survey results correlated more closely with the Bruininks-Oseretsky Test of Motor Proficiency results compared to gait analysis results. The changes in gait characteristics with the prosthesis showed no significant trends.

CONCLUSION

Subjective results suggest overall satisfaction with the prosthesis. Objective results show proper fit of the devices and variable impacts on gait characteristics and motor function when wearing the device.

14:25-14:35

Physician burnout and wellness in North American orthopaedic surgeons: A systematic review

Author: **Han**, M., Muwanis, M., Chhina, H., Cooper, A., Leong, C.

Supervisor: Dr. A. Cooper

PURPOSE

Occupational burnout in physicians has negative implications for the physician, their family, their patients, and to the healthcare system as a whole. The literature shows that the prevalence of burnout in attending level orthopaedic surgeons is highly variable by region and limited research has investigated orthopaedic surgeon burnout and wellness in North America. The systematic review conducted aimed to identify the prevalence, risk factors, and strategies to prevent burnout amongst North American orthopaedic surgeons.

METHODS

We conducted a systematic review of MEDLINE, Evidence Based Medicine (EBM), and the Cumulative Index of Nursing and Allied Health Literature (CINAHL) databases. All studies that included data on burnout or suggested risk factors and strategies to mitigate burnout in attending level North American orthopaedic surgeons were included. The systematic review was performed following the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) guidelines.

RESULTS

3112 records were independently screened by title and abstract by two reviewers. Conflicts were resolved via a third reviewer. 30 studies were deemed eligible and were included for data extraction, which was also done independently by two reviewers. Conflicts in data extraction were resolved via discussion. The reported prevalence of burnout amongst North American orthopaedic surgeons ranges from 20-59.6%. Risk factors for burnout were divided into 4 domains: demographic risk factors, personal risk factors, work environment risk factors, and social risk factors, with work environment risk factors being most frequently associated with burnout.

CONCLUSION

Burnout is still prevalent in many orthopaedic surgeons in North America, with the prevalence ranging from 20-59.6%. The studies included in this paper propose many strategies, mainly centered on maintaining a good work-life balance, facilitating group connectedness, or reducing administrative burden. We suggest that strategies to combat burnout should attempt to address risk factors in each of the four aforementioned domains. This study also provides valuable information regarding risk factors of burnout and prevention strategies that could be applicable to all healthcare professionals.

14:35-14:45

Identification of clinical and radiological indications for surgical treatment of genu valgum: a systematic review

Author: **Noopur** Ranganathan¹, Varun Muddaluru², Harpreet Chhina^{3*}, Anthony P Cooper³

*greatest contribution in helping student complete project '

Supervisor: Dr. Anthony P Cooper

Affiliations:

¹Oakland University William Beaumont School of Medicine, Rochester, Michigan

²Royal College of Surgeons in Ireland, Dublin, Ireland

³Department of Orthopaedics, Faculty of Medicine, University of British Columbia, Vancouver, Canada

PURPOSE

Idiopathic genu valgum is a lower extremity deformity that occurs in pediatric populations of all ethnicities and is usually treated surgically, either through hemiepiphyodesis or osteotomy. Currently, there is no standard methodology or guidelines for evaluating a patient for surgical treatment of genu valgum. Therefore, the aim of this review is to identify clinical and radiological indications for surgical treatment of genu valgum.

METHODS

Our search strategy involved a literature search conducted across five databases. PRISMA-P guidelines for systematic reviews were followed and articles were imported into COVIDENCE for screening. 73 studies were extracted into the following categories: 14 epidemiology, 30 hemiepiphyodesis, 14 osteotomy, and 15 surgical, clinical, or radiological indications of surgery.

RESULTS

At the time of abstract submission, 44 of the 73 studies have been reviewed (hemiepiphyodesis and osteotomy studies). 29 more studies remain to be reviewed. Based on the reviewed papers so far, clinical indicators include intermalleolar distance (IMD)>10 cm while radiological indications for surgical treatment include a medial tibiofemoral angle (mTFA)>15°. Significant reduction in angles like mechanical axis deviation (MAD), mechanical lateral distal femoral angle (mLDFA), mechanical medial proximal tibial angle (mMPTA), and mTFA were observed at the post-operative follow-up stage compared to pre-operative measurements. The studies proved to be 100% effective to correct genu valgum with some complications of overcorrection, plate and screw migration, and superficial wound infections.

CONCLUSION

Based on the results from this review, next steps are to conduct a Delphi study to establish guidelines for surgical treatment of genu valgum, which would ultimately improve clinical diagnosis and patient outcomes.

14:45-14:55**Application of virtual reality, augmented reality, and mixed reality in musculoskeletal undergraduate medical education: a scoping review**

Author: **Taewoong** Chae, Daniella D'Amici, Lise Leveille
Supervisor: Dr. Lise Leveille

PURPOSE

To assess the current level of utility for virtual reality, augmented reality, and mixed reality technologies in delivering musculoskeletal content for the undergraduate medical education.

METHODS

An appropriate search strategy was developed and reviewed in conjunction with a medical research librarian. A literature search was conducted using MEDLINE, EMBASE, and Educational Resources Information Center (ERIC) databases. Our search was restricted to studies published from January 1, 2010 to June 24th, 2022. Primary research studies reporting on the use of virtual reality, augmented reality, or mixed reality technologies in medical undergraduate musculoskeletal education were included. Studies which were not published in the English language, focused on surgical techniques outside the scope of undergraduate medical education, or non-primary studies such as conference abstracts, review papers, or opinion pieces, were excluded. Two authors independently screened at title, abstract, and full-text levels.

RESULTS

A total of 471 articles were screened. Eight studies were determined to fit our inclusion criteria. Analysis of the included studies presented that virtual reality, augmented reality, and mixed reality technologies are most commonly utilized in teaching anatomical and surgical topics for undergraduate medical musculoskeletal curriculum. Sample sizes ranged from 25 to 121 participants, and most studies were single-center. Research was conducted in various countries - United States of America, England, Ireland, Netherlands, China and New Zealand. Four studies assessed participant experience with virtual reality, augmented reality, or mixed reality; three out of four studies concluded the participants found the technology to be beneficial for learning, and in two of the four studies, the participants found the technology fun/enjoyable. Two studies found mixed reality technology to be more time efficient in learning anatomy than the traditional cadaveric methods.

CONCLUSION

The positive influence of virtual reality, augmented reality, and mixed reality technologies in medical education was synonymously reported across assessed studies. As the novelty, usability, and utilization of these interfaces continue to grow, as does the promise for further educational application. Future work should focus on teaching additional undergraduate musculoskeletal modalities, such as physical examination or casting. Furthermore, multi-center studies with larger sample sizes would increase support for adapting these technologies to medical curricula, and promote widespread change in pedagogy.

14:55-15:05**Safety and Efficacy of Elongated Screws for the Treatment of SCFE; a Prospective Observational Cohort.**

Author: **Arora**, Sana
Supervisor: Dr. Emily Schaeffer

PURPOSE

Slipped capital femoral epiphysis (SCFE) is a hip disorder most commonly diagnosed in adolescents in which the femoral head slips off the femoral neck at the growth plate. SCFE requires surgical management, and this study investigates the safety and efficacy of the elongated screw in preventing further slippage without disrupting normal proximal femoral growth.

METHODS

The SCFE Longitudinal International Prospective (SLIP) Registry was analyzed for patients diagnosed with SCFE whose surgical treatment involved the use of elongated screws. Patient demographics, diagnostic information, clinical, radiographic and surgical data were extracted from the SLIP registry REDCap database and analyzed to assess outcomes and complications following treatment.

RESULTS

A total of 81 elongated screws were used in the treatment of 73 hips in 46 patients; 50 hips were treated to fix a slip, while 23 hips were treated prophylactically. Average age at diagnosis was 12.1 years (95% CI [11.6, 12.6]). Patients were from five centres across Australia, the US, and Canada. 30/46 (65.2%) patients had risk factors for SCFE, with obesity being most common (20/46 patients, 43.5%). At diagnosis, 80.0% (40/50) of slips were stable, 16.0% (8/50) were unstable, and 4.0% (2/50) were of unknown stability. The average duration of symptoms prior to diagnosis was 10.6 weeks (95% CI [6.9, 14.2]). Elongated screws were primarily (44/46) used during the patient's index surgery; the remaining two patients required them at an additional surgery. In total, three (6.5%) patients suffered complications, one being femoral head penetration and 2 being implant failure requiring revision surgery. Average final follow-up was 8.3 months (95% CI [6.4, 10.2]) post-operation. At most recent follow-up, 28.3% (13/46) of patients had a limp, with one patient having a severe limp and the rest slight or moderate.

CONCLUSION

In a prospective cohort of 46 patients with SCFE treated by elongated screw, two patients (3.8%) experienced a complication related to the implant that necessitated revision surgery. The elongated screw appeared to adequately prevent slip progression in most patients. To strengthen the validity of this study, a larger patient population and a longer duration of clinical follow-up would be needed.

15:05-15:15**BREAK**

15:15-15:25**Mapping the landscape of Global Orthopaedics: A Scoping Review**Author: **Tarini Boparai**

Supervisor: Dr. Emily Schaeffer

PURPOSE/HYPOTHESIS

Newly-formed UBC Global Orthopaedics (UBC GO) has a mandate to facilitate department activities involving improving orthopedic care and outcomes in resource challenged communities globally. We are conducting a scoping review to determine the extent of progress in global orthopedics across existing literature and identify program evaluation metrics. The objective of this scoping review is to examine the current characteristics of global orthopedic initiatives, and identify reported barriers and gaps to inform UBC GO's actions to improve impact and increase accessibility of our own initiatives.

METHODS

We first conducted a preliminary search on Medline, Embase, WoS and Cinahl for "Global Orthopaedics" to inform our vision for the scoping review. Using MeSH terms associated with preliminary search articles, we refined our search strategy on Medline to include relevant terms such as 'Orthopedics', 'Global Health', 'Capacity Building' and 'Medical missions'. The search strategy will be expanded to Cabdirect, Embase and Scopus. Next, we developed an inclusion/exclusion framework based on three categories of global orthopedics initiatives: 1) Short-term surgical trips 2) Education-based programs; and 3) Capacity building programs. After

title/abstract/full text review, article demographics, category, initiative details, subspecialty and program evaluation metrics will be collected and analyzed.

RESULTS

To date, our Medline search strategy identified 1154 articles for abstract and title review. Two reviewers independently reviewed the first 50 search titles for inclusion/exclusion and categorization to check for agreement. We had over a 90% rate of agreement in both inclusion/exclusion and categorization. Now, we are progressing to executing our search strategy in other databases and moving towards full text review and data extraction.

CONCLUSION

Global surgery is a well-established and rapidly developing multidisciplinary field that is seeing an evolution of focus towards capacity building and sustainability initiatives. Orthopedic initiatives in relation to global surgery have been less well-defined, and thus their impact poorly understood. Through this scoping review we hope to understand the scope of existing work in global orthopedics to advance the impact, sustainability and accessibility of these activities with UBC GO.

15:25:15:35

Ultrasound Screening for Infants at-risk of Developmental Hip Dysplasia in BC: Assessing Access-to-Care

Author: **Fowler** Trevor, Miles Jaques, David Stephen-Tammuz, Kishore Mulpuri, Emily Schaeffer, Anya Smith
Supervisors: Dr. Emily Schaeffer, Dr. Kishore Mulpuri

PURPOSE

Developmental dysplasia of the hip (DDH) is a pediatric hip condition affecting 1 in 1000 newborns. Known risk factors include breech presentation, family history of DDH and history of clinical hip instability. Characterized by the presence of an abnormally developed acetabulum in one or both hips, DDH progression can usually be reversed with minimal intervention if diagnosed early in the life of the infant. However, missed cases or delayed diagnoses can result in more severe orthopaedic conditions, and may require invasive procedures to address. Currently, the distribution of resources to diagnose DDH in BC is imbalanced, with minimal access to care in many remote parts of the province. Consequently, infants province-wide are referred to BC Children's hospital for an ultrasound scan (US) appointment and further clinical care related to DDH. This project aims to provide baseline data critical to understanding the current landscape of DDH care in BC and inform areas that can be addressed to improve access to timely and appropriate care.

Our objectives are to assess: 1) Average age of the infant at the first US; 2) Risk factors or physical findings most common among infants referred for an US; 3) Distance travelled by patient families to receive DDH-related care at BCCH.

METHODS

This project is a Quality Assurance/Quality Improvement initiative. Patient medical record data abstraction sourced from PHSA PACS and CW Cerner is on-going. Our target is all children who received an US at BCCH in 2020 and 2021, and who were no older than one year old at their first US appointment. Select preliminary summary statistics are presented.

RESULTS

To-date, a total of 1320 patient records have been abstracted across years 2020-2021. Sex distribution was 54% female; 46% male. All health authorities were represented: Vancouver Coastal (68.3%), Fraser (29.4%), Interior (1.1%), Northern (0.5%), Vancouver Island (0.4%). The median age at the first US was 7.3 weeks (Range: 0.5-33.4 weeks). The most common indications for US referral were breech position (65.5%), a hip click (14.6%), and being the first-born child (10.5%).

CONCLUSIONS

Preliminary results suggest some infants are receiving US screening for DDH beyond the recommended age range (4-8 weeks) and the majority of indications for US referrals are consistent with known DDH risk factors. Completion of data abstraction will allow for a thorough assessment of travel distances required to receive care for DDH in BC.

15:35-15:45**Hip Displacement in Children with Leukodystrophies: a case series**Author: **Lam, Sheila**

Supervisor: Dr. Stacey Miller & Dr. Maria Juricic

PURPOSE

Leukodystrophies (LKD) are rare genetic disorders affecting primarily the white matter of the central nervous system. These disorders are progressive, and their natural history is not well-characterized. This study aims to address the current knowledge gap in the incidence rate of hip displacement and dislocation in these patients.

METHODS

In this retrospective review, children with LKD were identified through BC's hip surveillance program or the province's tertiary care pediatric orthopedic clinic. Clinical history, radiological exams and surgical data were analyzed. Migration percentage (MP) was utilized to identify hip displacement and progression.

RESULTS

Seventeen children (9 M, 8 F) with 7 different types of LKD (one unspecified) were identified. At the time of review, two children had died (age 6.3 and 14.5 yrs). The mean age at final follow-up (or death) was 13.9 yrs. 16/17 children were non-ambulatory (NA) with motor function classified at GMFCS level IV/V. The ambulatory child was treated for Krabbe disease with a bone marrow transplant and had no evidence of hip displacement at last follow-up (12.7 yrs, MPs of 12%(L), 5%(R)).

The mean age at first x-ray for all NA children was 4.3 yrs. The mean MP of 15/16 NA children was 44% as the initial imaging of one child could not be viewed. Three children had a hip dislocation at first x-ray (mean age 4.6 yrs, range 1.1-7.3 yrs).

11/16 NA children had undergone reconstructive surgery at a mean age of 7.8 yrs with 19/22 hips having a MP>30% at the time of surgery. In two NA children who had not undergone surgery (3.3 and 6.4 yrs), 3/4 hips had MP>30% (range 24-58%). Two additional youths had long standing dislocations; one required a salvage procedure at age 15.9 yrs. One child died at age 6.3 yrs prior to hip intervention (MPs 77% (L), 62% (R)).

CONCLUSIONS

The high prevalence of hip dislocation and progressive displacement in NA patients with all having MP>30% in at least one hip (28/32) warrants early and systematic surveillance. To ensure early detection of hip displacement in NA children with LKD, hip surveillance guidelines for NA children with CP should be followed. Global multi-centre collaboration is required to determine whether these guidelines should be refined.

15:45 – 15:55**Review Team Closing Comments**

15:55**ADJOURN**
