THE UNIVERSITY OF BRITISH COLUMBIA
Department of Orthopaedics
Faculty of Medicine

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UGME FALL RESEARCH FORUM

November 28, 2024 | 2:30 PM – 5:00 PM PST

THURSDAY, NOVEMBER 28, 2024

Chairs: Dr. Lise Leveille and Dr. Lauren Roberts
Review Panel: Dr. Michael Bond, Dr. Luckshman Bavan

Note:

1. Full presentations are strictly limited to **4 minutes**, followed by a **1-minute** discussion period with the review panel. Rapid fire presentations are limited to **3 minutes**, with a block of questions after the first group of 5 and the last group of 4 presentations.
2. Virtual attendees are encouraged to submit questions using the Zoom "Chat" function.

1430 – 1440:
Welcome and Housekeeping – Chairs

Research Presentations (4 min. present + 1 min. discussion)

1440 – 1445:
Hannah Locco - *A Comparative Analysis of percutaneous epiphysiodesis using transphyseal screw versus percutaneous drilling and curettage for Addressing Limb-Length Discrepancy* (Dr. A. Cooper)

1445 – 1450:
Bennett Stothers - *SCFE Diagnostic Times and Patient* Characteristics (Dr. Emily Schaeffer)

1450 – 1455:
Cameron Leong- *High prevalence of burnout and moral distress in Orthopaedic surgeons: a Canadian cross-sectional survey study* (Dr. Harpreet Chhina)

1455 – 1500:
James Ryeburn - *Percutaneous Lapidus Procedure for the Management of Primary Hallux Valgus Deformity – A Retrospective Cohort Analysis* **(**Dr. Alastair Younger**)**

1500 – 1505:
Jennifer Law - *Management of Type 1 Supracondylar humeral fractures during and after the COVID-19 pandemic: A Multicenter Randomized Control Trial (SCH-RCT)* (Dr. Harpreet Chhina)

1505 – 1510:
Karen Jiang - *Early identification of Developmental Dysplasia of the Hip through selective ultrasound screening in a community setting. A retrospective evaluation of the newborn hip ultrasound program on Vancouver Island* (Dr. Norgrove Penny)

1510 – 1515:
Sharon Shrestha - *Orthopaedic Complications in Rett Syndrome: A Case Series* (Dr. Kishore Mulpuri)

1515 – 1520:
Break

1520 – 1525:
Brianna Tsuyuki - *Hydrogen Peroxide as a Sustainable and Effective Solution for Reusable Intermittent Urinary Catheterization* (Dr. Dena Shahriari)

1525 – 1530:
Allie Cui - *Exploring instructional methods to optimize medical student learning in surgical clerkship: A narrative review* (Dr. Lise Leveille)

1530 – 1535:
Marie Keenan & Benjamin Nazif - *Assessing Content Validity and Inter- and Intra-observer Reliability of the Paediatric Surgical AdVerse Events Severity System (PedSAVES)* (Dr**.** Andrea Simmonds)

1535 – 1540:
Ben Rever & Kimathra Reddy - *Fully Implantable Device for Spinal Cord Optogenetics* (Dr. Dena Shahriari)

1540 – 1545:
Ali Hawkins - *Row to Grow: Pilot Community-Based Rowing Program for Youth with Cerebral Palsy* (Dr. Tim Bhatnagar)

1545 – 1550:
Josh Dyce - *Efficacy and Safety of Computer-Assisted Hexapod Fixators for Treatment of Limb Deformities in Pediatric Population: A Retrospective Review of Prospectively Collected Data from a Single Centre* (Dr. Anthony Cooper)

1550 – 1555:
Morgan Tidler - *An Assessment of Outcomes in the Operative and Non-operative Management of Pediatric Radial Neck Fractures – A Single-Centre, Retrospective Review* (Dr. Emily Schaeffer)

1555 – 1600:
BREAK

1600 – 1640
Rapid Fire Presentations (3 min. present)

1. Carolina Ricardo & Joel Maliakka l- Can a Novel AI-Based Predictive 3D Imaging Software for Idiopathic Scoliosis Obviate the Need for Routine Xrays?

2. Delaney Webber - Comparing observation vs. bracing in radiologically dysplastic, stable hips in infants with developmental dysplasia of the hip (DDH): A protocol for a global multi-centre non-inferiority randomized trial

3. Peter Jung - High Throughput Fabrication of Microchannel and Single Fiber Scaffolds for Axon Guidance and Tissue Regeneration

4. Jordan Thompson - Soft Electronic Implant for Bladder Management

5. Melody Li - Prospective memory differences between female and male Orthopaedic surgeons and their partners: An exploratory study

Question time

6. Maneeta Janjua & Samantha Tang - Canadian Care Pathway Guideline Development for the Screening and Surveillance of Developmental Dysplasia of the Hip

7. Veronica Jansen - Automated skeletal radiograph key-point detection and calculation of lower limb axes

8. Tamseela Ahmed - A prospective multicenter observational registry of pediatric orthopedic trauma and health outcomes (PedORTHO) in skeletally immature children

9. Gael Hernandez Palmer - Exploring the Views and Experiences of Children with Limb Differences and Their Parents on Receiving a Representative Toy

Question time

1640 – 1650:
Review Team Closing Comments

1650 – 1700:
Career in Orthopaedics Information Session with Dr. Fay Leung, Residency Program Director

1700 – 1900:
Canapes, Refreshments and Networking

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UGME FALL RESEARCH FORUM

November 28, 2024 | 2:30 PM – 5:00 PM PST

Title: A Comparative Analysis of percutaneous epiphysiodesis using transphyseal screw versus percutaneous drilling and curettage for Addressing Limb-Length Discrepancy
Authors: Elsa Alemayehu, Luckshman Bavan, Hannah Locco, Gourav Jandial, Harpreet Chhina, Khaled Skaik, Anthony Cooper
Supervisors: Anthony Cooper, Harpreet Chhina

Purpose/Hypothesis: Limb-length discrepancy (LLD) can lead to functional and cosmetic issues. Traditional methods for correcting LLD, such as drilling and curettage (PDC), have limitations and potential complications. Less invasive percutaneous epiphysiodesis using transphyseal screw (PETS) is gaining popularity due to fewer reported complications. This study aimed to compare these techniques in terms of success in reducing LLD, complications, and revision surgeries.

Methods: We did a retrospective review of patients less than 16 years old who underwent epiphysiodesis from January 1, 2015 to January 30, 2024. Demographics, surgery location, length of stay, revision surgery, and postoperative complications were compared across treatment groups. We compared LLD preoperatively and at skeletal maturity or end of study period. Total limb, femoral and tibial lengths were measured from radiographs to evaluate correction. Categorical data were summarized by frequency and percentage. We used mean, standard deviation (sd) or median and interquartile range for continuous data. We used chi square test to determine the effectiveness of procedures.

Results: Forty-one patients who underwent Epiphysiodesis for LLD in the distal femur (17.07%), proximal tibia (34.1%) or a combination (48.78%) were analyzed with a median preoperative LLD of 3cm [IQR 1.83]. Of these 41, 24 had PDC, 16 had PETS and 1 had a both. 56% of patients had achieved goals of surgery of LLD lower than 2 cm at skeletal maturity. Of these, 1 underwent both procedures, 11 had PDC and 11 had PETS. Eighteen patients [43.9 %] had not achieved goals of surgery, with 13 out of 24 with PDC [54.2%] and 5 out of 16 with PETS [31.25%]. As a complication of surgery, a total of 5 patients had coronal plane angular deformity. Of these, 2 had PETS, 2 had PDC and 1 had both. Angular deformities were noted in 4 femurs and 2 tibias. A total of 13 patients had revision surgery, 5 had PETS and 8 had PDC. All patients who had PDC had revision surgeries done to further manage the remaining LLD at skeletal maturity. Of the 5 patients in PETS group who had revision surgery, 2 were hardware removal, 1 was additional PETS and 2 had subsequent surgery done to address remaining LDD.

Conclusions: This study highlights the effectiveness of both PETS and PDC for LLD correction. It emphasizes the risk of coronal plane angular malalignment. These findings can help guide surgical decisions and improve patient care.

SCFE Diagnostic Times and Patient Characteristics

Presenting student: Bennett Stothers MSI 3 UBC
Primary Supervisor: Dr. Emily Schaeffer

Purpose: The objective of this project was to characterise the presentation characteristics of Clipped Capital Femoral Epiphysis (SCFE) patients in British Columbia and relate them to diagnostic times.

Methods: We conducted a retrospective cohort study with ethics approval from the UBC Clinical Ethics Review Board (H23-02281). A retrospective review of prospectively collected data was performed on patients enrolled in the SCFE Longitudinal International Prospective (SLIP) Registry at BC Children's Hospital (BCCH) in Vancouver Canada. We analysed data from 51 different patients (23 male and 28 female) age ranges from 5.98 years to 17.55 years with SCFE. Collected data included: sex, age, distance from BCCH, socioeconomic status (SES) estimated by postal code using the Canadian Index of Multiple Deprivation score, SCFE risk factors, stability, presentation type, presentation history, BMI, primary pain location, and weeks to diagnosis. Hazards ratios and p-values for risk factors for time to diagnosis of SCFE from Cox-proportional hazards models were calculated to analyse the effect of patient characteristics and presentation on time to diagnosis.

Results: Patients were diagnosed at an average age of 12.3 years (SD=2.4) and presented with an average BMI of 25.8 (SD=5). Percentage of participants with specific SCFE risk factors were: no risk factors 64.7%, family history of SCFE 23.5%, obesity 9.8%, hypothyroid 5.9%, genetic disorder 3.9%, and previous radiation to the hip 2%. Presentation type was: chronic 45.1%, acute 17.6%, acute-on-chronic 13.7%, and unsure 23.5%. Stability at presentation was: 70.3% stable, unknown 20.3%, and unstable 9.4%. Primary pain location was 56.9%, knee 25.5%, no pain 25.5%, thigh 15.7%, and unsure 3.9%. History of presentation was: limping 39.2%, pain worse with activity 21.6%, and limited hip ROM 9.8%. Median time to diagnosis was 8 weeks with a range of 1 to 72 weeks. The only factor that had a statistically significant impact on diagnostic time was presentation type. Using the acute presentation as a reference, acute-on-chronic and chronic had longer times to diagnosis HR: 0.2 and 0.25 respectively (p=0.01). Other hazard ratios of note, despite no statistical significance, were those for primary pain location. Hip and thigh pain had shorter times to diagnosis, HR 1.55 and 1.45 respectively, and knee pain had a longer time to diagnosis HR: 0.7.

Conclusion

In conclusion, there were a wide variety in both patient characteristics and presentation of SCFE. This data supports that clinicians should have a low threshold for including SCFE on the differential diagnosis for kids presenting with limp or pain in the hip or knee. In particular SCFE should not be forgotten about as a cause of knee pain in children.

Title: High prevalence of burnout and moral distress in orthopaedic surgeons: a Canadian cross-sectional survey study

Cameron J. Leong, Harpreet Chhina, Anthony Cooper

Purpose/Hypothesis: Burnout is defined as a high amount emotional exhaustion (EE), depersonalization (DP), and a low sense of personal achievement (PA). Occupational burnout in physicians has negative implications for the physician, their family, their patients, and the healthcare system. Burned out physicians are more likely to make medical errors and have a detached view of their patients. They are at an increased risk for depression, substance abuse, and suicide. Furthermore, moral distress, defined as the inability of an individual to act according to their core values and perceived obligations due to internal and external constraints, was found to be significantly associated with burnout amongst critical care providers. We aimed to determine the prevalence of burnout in Canadian Orthopaedic surgeons using the Maslach Burnout Inventory (MBI), identify risk factors for burnout, and evaluate the association between moral distress and burnout in Orthopaedic surgeons.

Methods: Trainees and attending-level Orthopaedic surgeons associated with senior author's University in Canada and the Canadian Orthopaedic Association were invited to participate in the study. Surveys were administered through REDCap. Participants were asked to complete demographic questions, the MBI, and an additional optional survey, the Measure of Moral Distress for Health Care Professionals (MMD-HP). Data were analyzed using R and risk factors were identified using a logistic regression model. A participant was deemed at risk for burnout if their EE was ≥20 or their DP score was ≥10.

Results: A total of 215 participants (28 trainees, 186 attendings) responded to the survey. The median EE and DP scores were 28 (IQR = 18-37) and 9 (IQR = 5-15) respectively. The prevalence of burnout among the entire cohort was 61.8%. The median moral distress score was 97 (IQR = 57-166). An adjusted logistic regression model identified MMD-HP score (OR=1.03, 95% CI=1.02 to 1.05, $p<0.001$) and hours worked per week (OR=1.07, 95% CI=1.00-1.16, p=0.089) as positively associated with burnout. In contrast, older age was negatively associated with burnout (OR=0.97, 95% CI=0.94 to 0.99, p=0.02).

Conclusion: These results suggest that the prevalence of burnout in Canadian orthopaedic surgeons is alarmingly high and moral distress may play a role in precipitating this. Future research should focus on a qualitative analysis of the perspectives of surgeons on the causes of burnout.

Percutaneous Lapidus Procedure for the Management of Primary Hallux Valgus Deformity – A Retrospective Cohort Analysis

J. Ryeburn, A. Barrie, A. Younger, A. Veljkovic, M. Penner, K. Wing, O. Gagne.

Purpose/Hypothesis

Hallux valgus deformity (HVD) affects approximately 35% of adults aged 65 and above.[1]
The traditional Lapidus procedure, though effective, involves open incisions. This study evaluates a percutaneous Lapidus technique to minimize postoperative wound complications by using a Shannon burr for cartilage removal preserving the subchondral bone, arthroscopy for visualization, and fixation with 4 mm non-variable pitch headless chamfered screws.
The aim was to assess radiographic correction and complication rates.

Methods

Inclusion criteria were percutaneous Lapidus for primary HVD between January 1st, 2018, and April 1st, 2023, in patients aged 16 and older, with at least 6-month postoperative follow-up. A retrospective review included 149 procedures in 130 patients; 19 were bilateral. 90.8% of patients were female.
31.5% of cases included a concurrent percutaneous Akin osteotomy.
Mean follow-up was 34 months.

Results

There were no deep infections or cases of nonunion.
17 cases (11.4%) had soft tissue irritation requiring hardware removal at a mean of 17 months post-procedure.
Complete pre- and postoperative radiographic imaging was available for 134 cases (90%).
Mean intermetatarsal angle decreased from 15.8º to 6.4º, hallux valgus angle from 32.3º to 12.2º, distal metatarsal articular angle from 30.6º to 10.1º, and sesamoid station from 9 mm to 2.8 mm.

Conclusions

Percutaneous Lapidus is a safe and effective treatment for primary HVD.
Our cohort showed no cases of nonunion of the first TMT joint or deep infection with a minimum of 6-month follow-up.
Postoperative soft tissue irritation rates were comparable to open techniques.[2]
Radiographic correction was satisfactory across a wide spectrum of deformities.

Acknowledgements

Special thanks to Dr. Alastair Younger for his supervision and Dr. Alasdair Barrie for his instrumental contributions to this project.

References

1. Nix S, Smith M, Vicenzino B. Prevalence of hallux valgus in the general population: a systematic review and meta-analysis. Journal of foot and ankle research. 2010

2. Vieira Cardoso D, Veljkovic A, Wing K, Penner M, Gagne O, Younger A. Cohort Comparison of Radiographic Correction and Complications Between Minimal Invasive and Open Lapidus Procedures for Hallux Valgus. Foot & Ankle International. 2022

Title: Management of Type 1 Supracondylar humeral fractures during and after the COVID-19 pandemic: A Multicenter Randomized Control Trial (SCH-RCT)

Authors: Harpreet Chhina, Jennifer Law, Hannah Locco, Sarah Metz, Paul Enarson, Anthony Cooper
Supervisors: Anthony Cooper, Harpreet Chhina

Purpose: Supracondylar humeral (SCH) fractures account for 50-75% of pediatric elbow fractures. Type I SCH fractures have no displacement or angulation of the distal humerus. Research on buckle fractures show that removable braces with no follow-up leads to excellent outcomes and high satisfaction. Previous results also show that immobilization of Type I SCH fractures with long soft casts have equal treatment outcomes to fiberglass casts. This study aims to compare the clinical outcomes and satisfaction of treating pediatric Type I SCH fractures with a removable soft cast and no clinical or radiographic follow-up versus standard of care (SOC) treatment in a fiberglass hard cast with clinical follow-up.

Methods: Patients aged 3-8 years with a Type 1 SCH fracture were recruited from BC Children's Hospital Emergency Department. Participants were randomized into the SOC hard cast or soft cast group. Clinical outcomes were recorded using REDCap at 3-weeks and 6-months post fracture. At 3-weeks, maximum pain score and unplanned returns to a physician were collected. At 6-months, patient reported outcomes were reported using PROOF UE and range of motion was assessed.

Results: We report on the interim results from our center only**.** At BC Children's Hospital, a total of 54 participants (26 SOC, 28 soft cast, mean age 5.75) were recruited. Thirty-nine 3-week follow-ups were completed. At 3-weeks, the mean maximum pain score was 2.36 (SOC) versus 2.53 (soft cast) and 4 unplanned visits to the hospital or a physician were reported. Twenty-eight 6-month follow ups were completed. For the SOC group, the median maximum extension, flexion, and carrying angle of the affected arm were 3°, 141°, and 6°, respectively. For the soft cast group, the corresponding values were 7°, 138°, and 6°. The mean parent-reported PROOF UE standardized scores were 99.70 (SOC) and 96.20 (soft cast), while the mean patient-reported standardized scores were 97.03 (SOC) and 98.35 (soft cast).

Conclusion: This is the first multicenter randomized control trial looking at the clinical effectiveness, safety and parental satisfaction of managing inherently stable Type I SCH without clinical or radiological follow-up.

Early identification of Developmental Dysplasia of the Hip through selective ultrasound screening in a community setting. A retrospective evaluation of the newborn hip ultrasound program on Vancouver Island.

Karen Jiang, Norgrove Penny*, Brent Weatherhead, Catherine O'Brien
*Supervisor

Purpose/Hypothesis

Ultrasound screening is effective for the early identification of developmental dysplasia of the hip (DDH) in newborns, a debilitating condition if not treated early. In 2003, a selective community-based ultrasound screening program was implemented on Vancouver Island. This program is conducted by two pediatric orthopedic surgeons using dynamic and static imaging. Newborns with risk factors for DDH are referred by primary care providers, pediatricians, and midwives. This study aims to describe and evaluate the program, providing insights to inform future screening guidelines.

Methods

This retrospective cohort study includes all patients who underwent hip ultrasounds through the Vancouver Island screening program between 2013-2023. Data on demographics, initial ultrasound, and management was collection. Patients were followed until their final imaging to monitor DDH. Preliminary descriptive statistics of data from 2013-2017 is presented.

Results

A total of 1056 patients underwent screening between 2013-2017, 64.1% female. The mean age at screening ultrasound was 6.20 weeks (1.0 - 45.0 weeks). Patients were referred for various reasons: 57.8% were breech (21.9% firstborn female breech, 5.9% firstborn male breech), 9.5% had family history of DDH, 18.5% had hip clicks and 10.5% had instability on clinical exams. The initial ultrasound was normal for 78.5% of patients, 12.3% had subluxated hips, and 2.3% had dislocatable or dislocated hips. In a selective analysis of one year of data, we identified 46 cases of unstable hips using the dynamic Harcke technique, however 11 of those (23.9%) had normal Graf angles. Of patients with abnormal ultrasounds, 77.4% were managed conservatively with healthy hip positioning and close monitoring, 20.4% were braced, and five patients (2.2%) underwent reduction in the operating room. Nearly all patients treated for DDH were followed long-term, for over two years, with normal final radiographs.

Conclusions

We describe an ultrasound screening program using Harcke technique for patients with DDH risk factors. Screening and close monitoring enables early and conservative management of most DDH cases, decreasing overtreatment with bracing and the risks of operative management.

Orthopaedic Complications in Rett Syndrome: A Case Series

Stacey Miller, Maria Juricic, Gabriella Horvath, Anita Datta, Sharon Shrestha, Kishore Mulpuri (Supervisor)

Purpose/Hypothesis: Rett syndrome (RS) is a rare, progressive, neurodevelopmental disorder with early childhood onset. In most children, the RS is caused by dominant X-linked mutations in the MECP2 gene. Orthopaedic complications in RS, including hip displacement, scoliosis, hand & foot deformities, & fragility fractures, have been reported but literature remains limited. The purpose of this study is to investigate the natural history & characteristics of these complications & orthopaedic interventions in children with RS in British Columbia.

Methods: In this retrospective review, children with RS are identified through a provincial hip surveillance program & a pediatric neurology clinic database. Clinical history, radiological exams, & surgical data are analyzed.

Results: 28 females with RS, with confirmed mutations in the MECP2 gene, were identified. Mean age at final follow up was 11.4 years (SD 6.2; range 1.2-28.1 years). 75% had epilepsy, with seizures controlled in 71%. A movement disorder was reported in 6 (21.4%) patients. Seven (25%) patients were still ambulatory at mean age of 9.8 years SD 3.4 (range 5.1-13.1 years) while 21 (75%) were independent sitters at mean age of 10.8 years SD 5.9 (range 1.2-28.1 years).
In total, 26/28 had pelvis imaging for review. At final follow-up, 3 participants (11%) had MP greater than 30% at mean age of 10.5 years (SD 5.6); all these children were non-ambulatory. None had undergone reconstructive hip surgery. The most common orthopaedic interventions were soft tissue & bony fusion of the feet (18%), spinal fusion for scoliosis (14%) & botulinum toxin injections (11%). Three fractures in 3 participants were identified. Data from 15 bone density assessments in seven participants were available; all z-scores except one were below -2.0 with mean Z-score across all locations being -4.1 (SD 1.5).

Conclusions: Surgical interventions for foot deformities was the most common orthopaedic intervention in this cohort of children with RS. Rate of hip displacement in children with RS has previously been reported to be like children with cerebral palsy but this review found the rate to be lower. Further review of this cohort, as they reach skeletal maturity, & prospective multicenter collaboration are required to gain understanding of orthopaedic complications in RS.

Hydrogen Peroxide as a Sustainable and Effective Solution for Reusable Intermittent Urinary Catheterization

Authors: Dr. Dena Shahriari and Brianna Tsuyuki

Purpose:
Intermittent urinary catheterization (IUC) is considered the gold standard to empty the bladder for those who experience bladder dysfunction. IUC reduces urinary tract infections (UTIs), promotes typical patterns of bladder voiding, and improves overall quality of life. Unfortunately, these catheters are manufactured for single use, requiring 4-8 new catheters daily, making obtaining new catheters for every use costly and unsustainable, particularly for those from underprivileged communities. Thus, the catheters are generally washed and reused following a wide range of recommendations available on health websites and blog posts. These recommendations vary from boiling a used catheter in water, to washing it with soap and water, vinegar, or bleach. However, a unanimous cleaning procedure clear of pathogens backed by scientific evidence is yet to be proposed. The most typical washing procedure with soap and water may not completely clean the catheter, which increases the risk of UTIs.

Hypothesis:
We hypothesize that washing catheters with 3% Hydrogen Peroxide (H202) will effectively remove bacteria and enable safe catheter reuse.

Methods:
In this study, disinfecting catheters with the common method of washing with warm water and soap is compared to soaking in a 3% H2O2 stock solution. Specifically, the efficacy of H2O2 is tested against catheters submerged in biofilms of Escherichia coli – the culprit of over 90% of UTI's, Streptococcus Aureus, another common bacteria in the urine, as well as human urine itself.

Results:
We show that biofilms of Escherichia coli and Streptococcus Aureus grown on commercially available catheters were removed entirely after being stored in H2O2 for 3 hours, which was not the case when washing with soap and water. In addition, the H2O2 solution could be reused for three weeks, with no colony formation.

Conclusion:
We present a simple and effective cleaning method to reuse catheters. Specifically, the user is recommended to place a used catheter without any rinsing in a stock of about 250 ml of commercially available 3% H2O2 . After a gentle 30s shake, leave the container for at least 3 hours. This method provides a sustainable and accessible method for users around the world including when traveling or in remote places without access to running water or any special equipment or tools.

Exploring instructional methods to optimize medical student learning in surgical clerkship: A narrative review

Cui, Allie. BHSc. Medical Student, UBC.

Leveille, Lise. MD. Clinical Assistant Professor & Director of UGME, Department of Orthopaedics, UBC.

Traditional teaching in surgical clerkship employs a combination of didactic lectures and clinical experience. The COVID-19 pandemic prompted a paradigm shift in educational systems that brought to light new methods of learning and teaching. While evaluating overall clerkship effectiveness is difficult, modifying didactic teaching sessions provides educators with a measurable opportunity to improve curriculum delivery and optimize student engagement.

Instructional methods with the strongest evidence for implementation are case-based learning (CBL), flipped classroom (FC) and gamification. CBL uses real-world scenarios to link basic sciences with clinical management, with its greatest strength lying in the emphasis on knowledge application. In FC settings, students learn material independently which frees up class time for active learning activities (ie. discussions, problem-solving). Knowledge outcomes achieved with FC are non-inferior to traditional methods, but contextual factors and student perspectives can hinder effective implementation. Gamification engages students through leveraging the intrinsic motivation associated with games. Although it is supported by a growing body of literature, educators must carefully consider the relevance of game elements to learning objectives to avoid undesired consequences.

Additional teaching tools include simulation-based teaching (SBT) and augmented reality (AR). SBT is commonly utilized for achievement of procedural competencies but is resource intensive and focuses on a different set of learning objectives. AR demonstrates significant potential; however, its use is still not yet well-established in medical education.

Finally, microlearning (ML) in medical education often takes the form of short, asynchronous learning activities that allow students to engage in self-directed learning with high-yield materials. While ML is not recommended as a standalone resource, it may pose as an effective supplement to traditional teaching material.

Overall, each approach to teaching has its own advantages and considerations. Feasibility of implementation needs to be considered alongside the desired learning goals when evaluating curriculum delivery design.

Title: **Assessing Content Validity and Inter- and Intra-observer Reliability of the Paediatric Surgical AdVerse Events Severity System (PedSAVES)**

Authors: Marie Keenan, BSc Candidate**,** Benjamin Nazif, BSc Candidate, Andrea Simmonds, MD, MHSc, FRCSC

Supervisor & Principal Investigator: Andrea Simmonds

Purpose:
Traditional, retrospective AE collection through administrative codes and systems such as the National Surgical Quality Improvement Program (NSQIP) have shown to be incomplete. The use of prospective AE collection tools, such as the Spine AdVerse Events Severity System (SAVES) and OrthoSAVES improve AE capture. Thus, a novel adaptation of these systems was developed for the Paediatric Orthopaedic population, the Paediatric Surgical AdVerse Events Severity System (PedSAVES). This study aims to evaluate the content validity and assess the inter- and intra-observer reliability of PedSAVES.

Methods:
Twenty case vignettes were developed, and surgeons, fellows, residents, and research members used the PedSAVES survey to report any adverse events they believed were present to assess the inter-observer reliability. One month later, the order of the case vignettes was shuffled, and the survey was completed again to test the intra-observer reliability.

Using a RedCAP survey that replicates the experience of using PedSAVES, adverse events are recorded prospectively from chart reviews. The AE collection using PedSAVES will be compared with data from traditional AE data collection (NSQIP, PSLS, etc.) to assess the content validity of PedSAVES.

Results:
Reliability testing revealed substantial agreement in diagnostic and severity assessments across both rounds. Gwet's AC1 values, ranging from 0.65 to 0.79, demonstrated strong inter-observer reliability in diagnostics. The consistently high ICC values (0.87 to 0.96) for average raters indicate excellent reliability in severity scoring. The Orthopaedic staff (Doctor-Only) at BC Children’s Hospital showed slightly lower reliability.

Validity testing is ongoing; therefore, we have no results to present at this time.

Conclusions:
PedSAVES has shown to be a reliable system, enhancing the replicability and consistency in the documentation of AEs. Validity testing of PedSAVES is ongoing, but we predict the system is effective, based on the assessment of SAVES. Therefore, implementation of PedSAVES is likely to improve AE documentation at BCCH. The long-term goal of this is to help decrease complications, improving our quality of care.

Fully Implantable Device for Spinal Cord Optogenetics

Authors: Ben Rever, Kimathra Reddy
Supervisors: Dr. Dena Shahriari, Adan Moallemi, Shahriar Shalileh
Faculty Contributor: Dr. Dena Shahriari

Purpose

Optogenetics is a technique that uses light-sensitive ion channels to control specific neurons with light, allowing researchers to study specific neural circuits and behaviors. While current methods exist for delivering light to the brain, new technologies are needed for targeting the spinal cord due to its increased movement-related stress. This project consists of an iterative engineering design process that aims at developing a wireless, biocompatible, and fully implantable optogenetic device for chronic optogenetic stimulation in rodent models. Additionally, Near Field Communication (NFC), a wireless communication technology, is being integrated to modify light delivery parameters on-the-fly.

Methods

To evaluate the structural integrity and biocompatibility of the device, we conducted in-vivo implantations and subsequent behaviour analysis. Surgical implantation procedures and securement strategies were developed to increase the device's reliability post implantation. Anatomical measurements of the spinal cord in rats and mice were taken to optimize the dimensions of the optogenetic probe. Further confocal microscopy and tissue staining for microglia and reactive astrocytes was conducted to evaluate damage or immune responses generated by the device. Lastly, the initial stages for a miniaturized flexible antenna required for NFC integration was designed using CAD software.

Results

Initial results and behaviour analysis from ongoing in-vivo studies indicated long term stability in rats. The thickness of the probe and its biocompatible polymer coating was reduced to a 120µm thickness to avoid spinal cord deformation. These adjustments allow for a possible new implantation technique placing the probe underneath the lamina for optimal light delivery. Immunohistochemistry results showed slight inflammation response, but continuing studies aim at validating the tolerance of the modifications in-vivo. Initial steps of NFC integration included preliminary antenna design and successful electronics configuration for proof of design and concept. Ongoing work will integrate this technology into the device itself during fabrication.

Conclusions

Significant advancements were made in refining our optogenetic device for chronic use in the rodent spinal cord. We improved the structural integrity, refined implantation standards and techniques in rats, and gained new information on the devices physiological impact and immunological response. We are now in the process of implementing the updated design in a final investigation to determine its efficacy in mice and rats for chronic spinal cord stimulation studies.

Supervisor: Tim Bhatnagar, PhD

Row to Grow: Pilot Community-Based Rowing Program for Youth with Cerebral Palsy

Karen Davies [1,2], Ali Hawkins [1,3], Tim Bhatnagar [1,4,5], Farah T. Azim [1], Diane Wickenheiser [1], Courtney Pollock [2,6], Lise Leveille [1,4,5]

[1] The Motion Lab, Sunny Hill Health Centre at BC Children's Hospital, [2] Dept. of Physical Therapy, Faculty of Medicine, UBC, [3] School of Biomedical Engineering, Faculty of Applied Science, UBC, [4] Research Institute, BC Children's Hospital, [5] Dept. of Orthopedics, Faculty of Medicine, UBC, [6] Rehabilitation Research Program, Centre for Aging SMART, Vancouver Coastal Health Research Institute

Purpose/Hypothesis

Youth with cerebral palsy (CP) often present with functional limitations impacting quality of life and future musculoskeletal health. Closed kinetic chain activities, such as rowing, have been shown to improve gait and functional metrics as well as increase self-reported quality of life measures in youth with CP. Rowing has been anecdotally observed in other communities to improve function and quality of life in this population. The purpose of this study is to use 3D motion capture technology to evaluate the effects of participating in a learn to row program for youth with CP on their walking and rowing biomechanics.

Methods

Youth aged 12-18y (n=8, 8 males) had two visits to The Motion Lab at Sunny Hill Health Centre at BC Children's Hospital, one before and one after participating in a 3-month rowing program. During each visit, sagittal plane joint range of motion (ROM) for the ankles, knees, and hips was collected using a Qualisys 12-camera motion capture system. Passive reflective markers were used to capture kinematics while the participants walked in the lab and rowed on an ergometer. Data analysis will involve comparing joint ROM at baseline and after the rowing program, along with a paired t-test to determine if the rowing program significantly improved the joint ROM while walking.

Results

Youth participated in a 3-month summer/fall learn to row program at six different rowing clubs around the Lower Mainland and Vancouver Island. Pre-visit data has been analyzed and plotted to record a baseline measure for each adolescent before participating in their respective learn to row program.

Conclusions

Evidence of improved gait biomechanics due to involvement in a rowing program could identify a promising activity for youth with CP to partake in across the province to improve their mobility. Furthermore, evidence supporting rowing as a beneficial activity could help to secure further funding for a sustainable rowing program for youth with CP across BC.

Title: Efficacy and Safety of Computer-Assisted Hexapod Fixators for Treatment of Limb Deformities in Pediatric Population: A Retrospective Review of Prospectively Collected Data from a Single Centre
Authors: Harpreet Chhina, Josh Dyce, Jennifer Law, Gourav Jandial, Anthony Cooper
Supervisor: Anthony Cooper, Harpreet Chhina

Introduction: This study aims to review the efficacy and safety of Computer Assisted Hexapod Fixators (CAHFs) (Orthex, Orthopediatrics, Warsaw Indiana) for treatment of limb deformities in pediatric population.
Methods: We performed a retrospective review of prospectively collected data for patients who had received a CAHF for their treatment between September 2017 and July 31, 2024.

Data were collected on demographics, reason for frame application, number of pins/wires, reported adverse events (AEs), number of pin/wire site infections, and number of infections resulting in implant removal. Limb alignment angles were measured from X-rays and an absolute change in angles was calculated for each patient. An average of this absolute change per patient was calculated.

Results: There were 49 CAHFs (3 upper limb, 46 lower limb) (270 pins and 88 wires) used in 42 patients during the review period. 30 frames were applied on tibia only, 14 out of 49 frames were used in patients with Fibular Hemimelia followed by 5 each for patients with Blount's disease, Genu Varum, and post-traumatic deformity. The average age at frame application was 13.1 years (range 1-23 years). The mean rate of pin and wire site infection was 0.54 and 0.36 respectively. There were 24 AEs reported. Three out of 24 AEs were classified as 'Severe'. However, none of the AEs resulted in permanent damage. These 'Severe' adverse events were 1 peroneal nerve palsy, 1 osteotomy site infection, and a fracture at the pin site discovered at routine frame removal.

Conclusion: CAHFs showed excellent results for lengthening and correction of deformity with no AEs resulting in permanent damage to the patients.

Significance: CAHFs are safe to use for deformity correction and limb lengthening in pediatric population with a low rate of complications despite the high number of congenital cases in this series.

Attachment 1: Demographics

Attribute			
Number of patients	42		
Number of Frames	49		
Number of Pins	270		
Number of Wires	88		
Gender	Male	Female	
	23 (55 %)	19 (45 %)	
Location of implant			
Location	N	%	
Tibia + Fibula	5	10%	
Tibia	30	61%	
Humerus	1	2%	
Tibia + Foot + Fibula	2	4%	
Radius + Ulna	1	2%	
Ulna	1	2%	
Femur + Tibia	2	4%	
Tibia + Fibula	5	10%	
Foot + Fibula	2	4%	
Age at frame application (years)	Average	Minimum	Maximum
	13.14	1	23

Diagnosis		
Diagnosis	N	%
Fibula Hemimelia	14	29%
Blount's Disease	5	10%
Genu varum	5	10%
Post Traumatic Deformity	5	10%
Joint Contracture	2	4%
Leri-Weill dyschondrosteosis.	2	4%
Hurler Syndrome	2	4%
Achondroplasia	2	4%
X-linked hypophosphatemia rickets	2	4%
Skeletal Dysplasia	2	4%
Tibial Hemimelia	1	2%
Benign tumors	1	2%
Ollier's disease	1	2%
Posteromedial bowing of tibia and fibula + Clubfoot	1	2%
Genu recurvatum	1	2%
External tibial torsion	1	2%
in utero Amniotic Band Deformity	1	2%
Spondyloepiphyseal dysplasia	1	2%
Purpose of frame		
Purpose	N	%
Lengthening + Deformity Correction	23	47%
Lengthening	12	24%
Deformity Correction	14	29%

Attachment 2: Summary of results

	Lengthening	**Lengthening + Deformity Correction**	**Deformity Correction**	**All frames**
Average time in frames (Days)	263	228	188	225
Time to bony union/consolidation (weeks)	140	113	109	119
Rate of Deformity correction	1 degree per day			
Mean Lengthening Per Day (mm)	0.78	0.85	N/A	0.83
Planned Total Lengthening (mm) (Mean, Median, and range)	45, 50, [10-50]	37, 50, [2.5-60]	N/A	40, 50, [2.6-60]
MPTA (absolute average change) (degrees)	9.8	9.9	9.3	9.3
LDTA (absolute average change) (degrees)	7.0	8.8	3.0	5.0
MAD (absolute average change) (mm)	17.6	39.6	20.7	25.0

Non-union rate	0	0	0	0
Total pins (Frames)	69 (12)	123 (23)	78 (14)	270 (49)
Mean rate of pin site infection (infections per pin)	0.90	0.39	0.48	0.54
Total wires (Frames with wires)	31 (7)	35 (7)	22 (12)	88 (26)
Mean rate of wire site infection (infections per wire site)	0.30	0.38	0.39	0.36

Attachment 3: Clavien-Dindo Classifcation

Clavien-Dindo Grade	Count
I	12
II	2
IIIa	4
IIIb	6

Attachment 4: CIOMS Severity Classification

Severity Classification	Count
Mild	15
Moderate	6
Severe	3

*The Council for International Organizations of Medical Sciences (CIOMS). *Management of safety information from clinical trials: Report of CIOMS Working Group VI*. (2005).

Attachment 5: Adverse Events relation to implant and/or surgery

Description	Count
Reasonable possibility the implant caused the event	6
Reasonable possibility the surgery caused the event	11
Reasonable possibility both the implant and surgery caused the event	3
Unlikely the implant or the surgery caused the event	4

Title: An Assessment of Outcomes in the Operative and Non-operative Management of Pediatric Radial Neck Fractures – A Single-Centre, Retrospective Review

Authors: Dr. Jeffrey Pike, **Morgan Tidler**, Bahman Panjavi

Supervisor: Dr. Emily Schaeffer

Purpose: In the literature, there is no consensus regarding the degree of angulation and translation that can be tolerated in pediatric radial neck fractures. Thus, controversy exists surrounding the optimal treatment, such as when to move from closed reduction attempts to an open-reduction procedure. The objectives of this research study were to comparatively assess operative and non-operative management through identification of acceptable angulation and translation measurements in Type II+ pediatric radial neck fractures.

Methods: Patients under the age of 18, presenting with a radial neck fracture and follow-up clinical data between January 1, 2010 and August 1, 2023, were identified through a SunSet text search and included in the study. Demographic data, clinical and radiographic data, treatment/operative details, and post-operative clinical and radiographic outcomes were deidentified and entered into a REDCap database. This included age and sex; Judet classification; angulation and translation; range of motion (ROM); complications; and radiographic images. Qualitative data analysis was conducted, and descriptive statistics were used for quantitative variables.

Results: 40 patients had diagnoses of Judet II (< 30° angulation) or above. Patients who sustained higher severity fractures (> 60° angulation) were likely to be older (9.1 ± 1.2 years) than those who sustained lower severity fracture types, like Judet II (7.7 ± 0.9 years). When angulation and translation were ≤ 20° and ≤ 25% respectively, non-operative management yielded functional (defined by a minimum 30°-130° flexion arc and 50°/50° pronation/supination) and pain-free ROM. Operative treatment was indicated when closed reduction failed to achieve alignment. Internal fixation was crucial in preventing loss of reduction and associated with fewer complications.

Conclusions: Most radial neck fractures heal without long-term issues. However, poor outcomes were more common in older patients (>10 years), high-energy injuries, or in cases involving early motion. Operative cases with internal fixation had a low complication rate. Regular 1-week follow-ups with x-rays are recommended for both operative and non-operative cases to ensure proper healing.

Can a Novel AI-Based Predictive 3D Imaging Software for Idiopathic Scoliosis Obviate the Need for Routine Xrays?

Authors/ Co-Authors: Joel Maliakkal, Carolina Ricardo, Shaina Sim, Abdullah Alduwaisan Firoz Miyanji

Supervisor: Firoz Miyanji

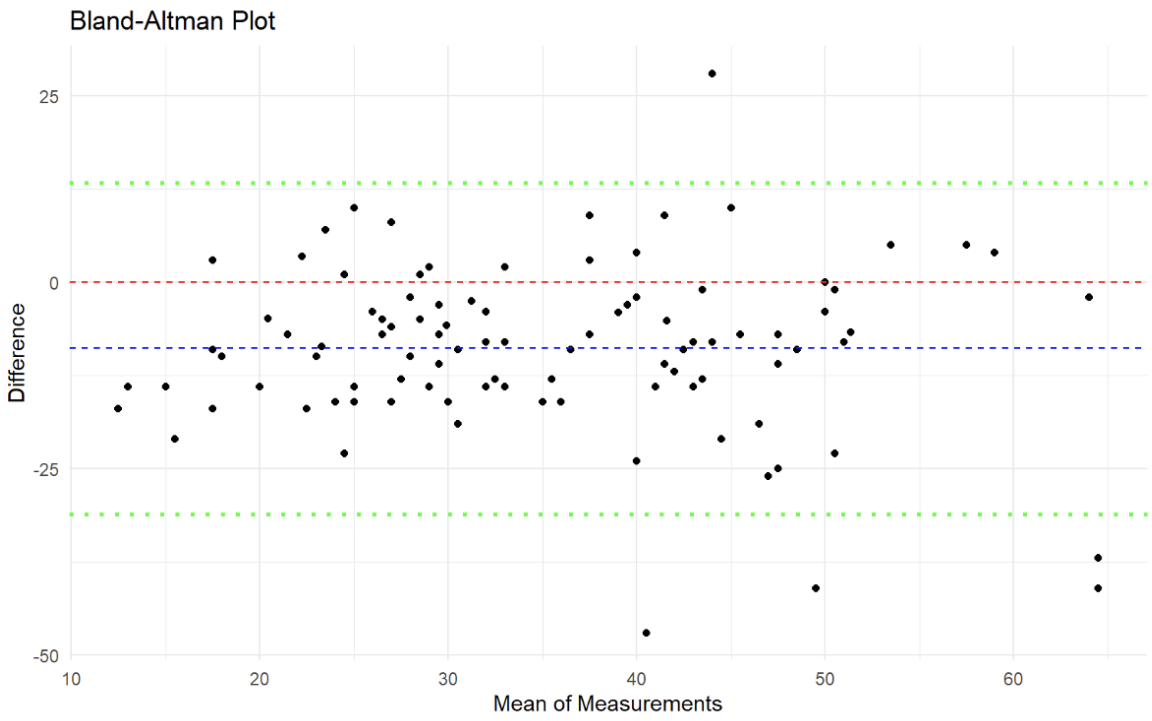
Purpose:
Idiopathic Scoliosis (IS) is a three-dimensional (3D) spinal deformity that causes noticeable changes in the physical appearance of the patient's torso. Current clinical practice involves full-length scoliosis x-rays to diagnose scoliosis with interval x-rays to follow curve progression. Shortfalls of current care models have prompted the development of a 3D imaging software consisting of a 360 circumferential clinical video of the thorax, abdomen, and lower extremities of patients to quantify the topographic malalignments associated with scoliosis. This study aims to validate the predictions produced by the 3D imaging software, namely the presence/absence of scoliosis and curve severity.

Methods:
Patients diagnosed with IS were recruited prospectively from a single-centre, high volume pediatric spine center. All patients had routine scoliosis x rays taken as per standard care and in addition two clinical videos were taken using the application (one in standing position, and one in Adam's forward bend). The videos were uploaded and transformed into 3D models. An algorithm was then used to produce an asymmetry index to determine the AI predicted major Cobb angle. Demographic data were collected from chart review, and actual major Cobb were measured by a member of the clinical care team. Spearman correlation determined strength of correlation between AI predicted Cobb and actual measured Cobb. Bland-Altman analysis determined agreement between the predicted and measured major Cobb.

Results:
115 patients (80% females, 20% males; mean age 14.6 [SD 2.2]) were recruited. The mean major Cobb for all participants was 39.5° (16-85); 72.2% had main thoracic, 24.3% had lumbar/thoracolumbar, and 3.5% had proximal thoracic curves. Eighteen scans failed to generate predictive models. Mean AI-predicted Cobb was 30.8° (4-63). The 3D imaging software correctly identified the presence of scoliosis in 94.9% of patients, with a positive predictive value of 1. The Spearman correlation coefficient was 0.69, indicating a moderate-strong positive correlation between the measured and predicted Cobb. The Bland-Altman analysis highlighted a mean difference of -8.86 (predicted Cobb was 8.86° lower) with limits of agreement between 13 and -31.

Conclusion:
There is a moderate-strong positive correlation between the AI-predicted and measured Cobb, suggesting 3D imaging software can accurately diagnose scoliosis in majority of cases. Therefore, in the future the software may be beneficial tool for diagnosing scoliosis, obviating the need for screening x-rays.

Figure 1 – Bland-Altman analysis of predicted vs measured Cobb



Red line – perfect agreement between two measurement methods

Blue line – mean difference between two measurement methods

Green line – 95% limits of agreement

Comparing observation vs. bracing in radiologically dysplastic, stable hips in infants with developmental dysplasia of the hip (DDH): A protocol for a global multi-centre non-inferiority randomized trial

Bryn Zomar, Jeffrey Bone, Vuong Nguyen, Simon Kelley, Kishore Mulpuri, **Delaney Webber**, Emily Schaeffer (Supervisor)

Purpose/Hypothesis
Bracing is used for radiological dysplasia (RD) in infants with DDH; however, it's unclear whether it provides significant benefit over ultrasonic observation. If observation is non-inferior to bracing for RD, unnecessary treatment may be avoided. This study serves to determine whether observation is non-inferior to bracing for infants with RD.

Methods
This is a multi-centre, global, randomized, non-inferiority trial performed within the Global Hip Dysplasia Registry (GHDR). Included patients must have RD (centred hip, alpha angle 43-60°, % femoral head coverage 35-50% measured on ultrasound) of a clinically stable hip before 3 months of age. Patients are excluded if they have clinical hip instability, received prior treatment or have known/suspected neuromuscular, collagen, chromosomal or lower-extremity congenital abnormalities or syndromic-associated hip abnormalities. Enrolled patients are randomized to observation or Pavlik bracing for at least 6 weeks. Follow up visits occur at 6 weeks, 1 year & 2 years post-enrollment. The primary outcome is the acetabular index on the 2-year radiograph with a 3° non-inferiority margin. A total of 514 patients will be enrolled. We used GHDR to pilot the feasibility of the trial's recruitment, eligibility criteria & treatments. We report the results of pilot data collected since 2021 and update the status of the trial.

Results
We've enrolled 309 patients with clinically stable hips in GHDR since 2021. Of these, 265 patients were initially braced & 42 patients monitored. Since the launch of the RCT, 10 patients have been enrolled with 9 centres recruiting.

Conclusions
Pilot data demonstrates the feasibility of achieving sufficient recruitment for this trial. However, the observational nature of the registry highlights the need for such a trial: it's likely many patients were initially braced due to centres not enrolling into the registry until the decision to treat had been made. The limited existing literature compels a better understanding of the natural history of RD hips to inform more consistent guidelines backed by the substantial evidence generated by a well-executed randomized trial

High Throughput Fabrication of Microchannel and Single Fiber Scaffolds for Axon Guidance and Tissue Regeneration

Peter Jung[1,2], Teela Moore[1,2], Elham Mohseni[1,2], Dena Shahriari[1,2,3]

[1]International Collaboration on Repair Discoveries (ICORD)

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Purpose/Hypothesis

Spinal cord injury impacts between 250,000–500,000 individuals annually, inhibiting motor and sensory functions through nervous system damage. Regeneration of damaged axons along their neuronal pathways is key to recovery, but sporadic regeneration hinders neuron growth. Porous, biomaterial scaffolds can linearly guide axons enhancing organizational growth while allowing for nutrient diffusion to accelerate regeneration. These scaffolds can be multi- or single-channeled for central or peripheral nerves respectively.

Methods

This work explores 2 methods of scaffold fabrication. To 3-D print biomimetic microchannel scaffolds, a design was created with SOLIDWORKS CAD software using the rat T4 spinal cord dimensions as reference. A solution of polycaprolactone and ball-milled salt particles was made into pellets via doctor blading then heat pressing. After printing, salt-leaching dissolved the NaCl, creating interconnected pores.

Another approach uses thermal drawing process (TDP), a manufacturing technique that draws long, precise fiber strands with high throughput. By customizing input stock material, desired macro-scale shapes and properties are achieved, such as biomimetic design. The material is then heated and drawn into meters of fibers, allowing for microscopic, single-channeled fiber conduits with applications in tissue regeneration or nerve guidance.

Results

Microscopy imaging confirmed a biomimetic design with 0.2mm thickness and no interior salt particles, verifying pore interconnectivity. In a rat model, the scaffold remained securely in place in a lesion at T4 after three days, without the need for sutures or glue.

Conclusion

Porous, multichannel scaffolds were successfully fabricated using the laid-out methodology. 3-D printing allows for a one-step manufacturing process with high-throughput capability with a design customizable to a person's unique injury. Further, a working TDP tower prototype has been manufactured to increase the fabrication throughput of future conduits. Manufactured scaffolds will proceed to in-vivo testing in rats, validating the fabrication methods for use in mass production and clinically relevant settings.

Soft Electronic Implant for Bladder Management by Jordan Thompson, Elham Mohseni, Shahriar Shalileh, and Dena Shahriari.

Purpose and Hypothesis
Neurogenic underactive bladder (NUB) conditions impact individuals with spinal cord injury (SCI), diabetes, Parkinson's, and Multiple Sclerosis (MS). The poor contractility of the detrusor muscle in NUB causes difficult and incomplete urination, leading to vesicoureteral reflux and kidney stones. This project introduces a novel approach to assist bladder voiding using a wirelessly operated mechanical actuation. The device, a soft electronic actuator, incorporates shape memory alloys (SMAs) that are insulated by a silicone elastomer to increase flexibility and minimize actuation temperature.

Methods
The implantable device is controlled via a Bluetooth Low Energy system, allowing for wireless operation. The device can be controlled from the user's mobile device. The implant consists of a control module, battery, and the actuator itself. The control module consists of a nrf52840 chip to program the device, and voltage regulators to control each actuator. Various actuator designs have been developed including a band, hemisphere, and ring design, compatible with rodent bladder size and geometry. In each design, the SMA actuators are embedded in a silicone elastomer. In vitro testing includes a phantom bladder which is filled with saline and attached to the actuator. The mass of voided saline, the flow velocity of the saline and the maximum temperature during actuation are recorded. Different algorithms for actuation are tested with each design. In vivo tests are completed by catheterization of rodent models. The difference in saline voided compared to saline in the bladder is measured.

Results
Preliminary results indicate that the actuator can achieve voiding efficiencies up to 26% in vivo and 76% in vitro. Several designs have a maximum temperature less than 40 º C, with internal an internal temperature greater than 60 º C. The average percentage strain of the hemisphere actuator is 42%. Recovery animal studies show that the device can be implanted for one week without tissue damage or impacting the animal's ability to urinate.

Conclusion
These results show the potential of a user controlled and personalized soft electronic actuator to induce on-demand mechanical contraction. Further testing will include recovery animal studies, developing a control system with a capacitive strain sensor, and developing a user interface.

Prospective memory differences between female and male orthopaedic surgeons and their partners: An exploratory study

Melody Li (Supervisors: Bonita Sawatzky, Fay Leung)

Purpose:

There is limited exploration of the cognitive dimensions of household work, hindering understanding of sex inequality in contemporary Orthopaedic households. Do household mental loads differ between female and male orthopaedic surgeons?

Methods:

A survey was available to all training, practicing, or retired BC Orthopaedic surgeons. Inclusion criteria: understand written English, live with a partner, and take care of a dependent (i.e. a child, an elder, or an adult requiring care). The survey included the validated 20-item questionnaire Prospective Memory (PM) Demands Measure and Perceptions of Partner's PM Demands Measure, which measured orthopaedic surgeons' **perceptions of their own mental load** and **perceptions of a partner's mental load**, for **themselves,** their **partner**, and their **dependent** (child or adult requiring care). Sum scores were calculated (Table 1). A 2-way ANOVA was performed with the dependent variable being PM and independent variables being sex (M/F) and age (<44yrs>).

Results:

Participants included 26 surgeons from around BC. All the females were under the age of 45 years old. For the males, 68% were 45 years+.

Table 1. Means for Surgeon's PM and their perception of Partners' PM.

	Overall	**Female (N-7)**		**Male (N=19)**		
		<44	**>44**	**<44**	**>44**	**Total**
Surgeon's PM for						
Dependent	8.54	8.57		7.33	9.08	8.53
Partner	6.69	4.29		9.17	6.85	7.58
Self	14.38	15.00		15.50	13.54	14.16
Perceptions of Partner's PM For						
Dependent	8.85	7.86		10.00	8.85	9.21
Surgeon	5.12	4.29		***9.83**	3.38	5.42

*__Significant difference (<.05) with respect to age and sex.__

For PM demands related to self, partner and dependents, there were no significant interaction effect was found between age nor sex. There was a significant main effect of age and sex for perceived partner's PM demands for surgeon, where younger males had a higher mean score than females and older males.

Conclusion:

Younger male surgeons perceived higher PM for their partners than females and older males. This shift by younger male surgeons might be due to the evolving work-life balance landscape, where men are increasingly engaged in family roles and women are more actively participating in the workforce. Further research is needed to explore the presence and reasons for inequitable division of mental load in the surgeon's household.

Canadian Care Pathway Guideline Development for the Screening and Surveillance of Developmental Dysplasia of the Hip

Author
Dr. Emily Schaeffer (Supervisor)
Alyssa Robinson
Maneeta Janjua (Student)
Samantha Tang (Student)
Jacqueline Li
Dr. Kishore Mulpuri
Dr. Sukhdeep Dulai

Purpose/Hypothesis:
Canada currently lacks a standardized approach for screening developmental dysplasia of the hip (DDH), which contributes to delayed diagnoses and more invasive surgeries that lead to complications. The development of a DDH care pathway aims to improve patient outcomes by reducing the incidence of late or missed DDH cases. This multi-phase process for DDH care pathway development will guide DDH care providers through the process of screening, diagnosis and referral.

Methods:
In Phase I, specialty-specific surveys were administered to Orthopaedic surgeons, pediatricians, radiologists, midwives, family doctors, nurse practitioners, and nurses to examine resource availability, practice patterns, and opinions regarding DDH screening. An expert panel, composed of representatives from these professions across Canada, was assembled to participate in a literature review process to establish a foundational evidence base, followed by a Delphi consensus-building process. In Phase II, panelists will participate in multiple Delphi rounds to achieve consensus on a set of DDH screening guidelines. The resulting consensus statements will inform the development of the care pathway.

Expected Results:
Upon dissemination of a preliminary Delphi survey amongst the expert panel, a maximum of four Delphi rounds are expected to be conducted for the panel to reach a minimum of 80% consensus on 30 to 60 guideline statements. The guidelines will likely integrate regular DDH screening into baby well-child checks for a minimum of three months of age. Additional screening criteria will be incorporated based on the presence of DDH risk factors in babies and accessibility to ultrasounds and x-rays across Canadian regions.

Conclusion:
Establishing a DDH care pathway for the Canadian context will standardize DDH screening and diagnosis to reduce variability. The guidelines will also account for differences in patients' accessibility to care, presence of screening tools, number of local DDH care specialists, and other relevant barriers. The care pathway development methodology can be used in other countries to develop a standardized practice for the screening, diagnosis, and care of DDH and other disorders.

Automated skeletal radiograph key-point detection and calculation of lower limb axes
Authors: Gael Hernandez Palmer, Taqdir Ali, Veronica Jansen, Dr. Harpreet Chhina, Dr. Anthony Cooper
Principle Supervisors: Dr. Harpreet Chhina, Dr. Anthony Cooper

Purpose This study aims to develop a machine learning algorithm, using convolutional neural networks (CNNs), to automate the detection of key-points within and calculation of skeletal alignment in pediatric standing lower limb radiographs. Accurate measurement of alignment is crucial for diagnosing skeletal pathologies like dysplasia, metabolic disorders, and joint degeneration. Current manual methods for evaluating limb alignment are time-intensive and prone to inter-observer variability. This study's goal is to make an automated alternative that improves clinical efficiency, accuracy, and reliability.

Methods This study will use previously collected de-identified pediatric lower limb radiographs to train a CNN model for the automatic detection of key anatomical points in anteroposterior (AP) full-length standing radiographs. The study will focus on key-point labelling of bony landmarks of the lower limbs which will be used to calculate lower limb axes. An algorithm will be developed for automated calculation of these axes. The model will be trained on a dataset of radiographs, with key-points labelled manually as a reference for algorithm training and then will be evaluated by comparing with human-calculated values. Intra-observer reliability will be tested to validate the dataset used for training.

Results The primary outcome will be a validated CNN model that can accurately identify anatomical key-points and calculate lower limb axes. Its performance will be compared to human calculated values and analyzed statistically to determine intra-observer reliability and the accuracy and reliability of the automated system. The software interface will also be tested for integration into clinical workflows.

Conclusions This research aims to create an automated, machine learning-based system to assist in the assessing pediatric lower limb alignment from radiographs. By automating the key-point detection and axis calculation, the system will reduce the time and subjectivity involved in manual analysis, potentially leading to more accurate diagnoses and better patient outcomes. A user-friendly interface will also enhance the clinical applicability and support the widespread use of the algorithm in pediatric orthopedics.

Title: A prospective multicenter observational registry of pediatric orthopedic trauma and health outcomes (PedORTHO) in skeletally immature children

Supervisor: Emily Schaeffer
Authors: Kishore Mulpuri, Bryn Zomar, Alexander Joeris, **Tamseela Ahmed**, Emily Schaeffer

Purpose: Current literature on pediatric long bone fractures and traumatic hip dislocations lacks high-quality clinical evidence or consensus regarding the preferred treatment: operative or nonoperative. The objective of the PedORTHO study is to collect data on these injuries and health outcomes in skeletally immature kids. This study aims to identify treatment variability among surgeons and centers, as well as treatments that yield the best outcomes, particularly where clinical equipoise and management controversy are significant.

Methods: This study reviews prospectively collected data of children worldwide recruited within 8 weeks of sustaining one of 6 fracture types and receiving treatment within 4 weeks of injury, with confirmation of open physis. The exclusion criteria include having polytrauma, previous fracture of the same anatomical region and underlying neuromuscular and musculoskeletal disorder. Eligible fracture types include proximal humerus, distal humerus, proximal radius, forearm shaft, femoral neck, tibia shaft, and traumatic hip dislocations. All treatment, post-treatment, and follow-up visits are conducted according to each site's standard of care. Outcomes include radiographic data specific to fracture type and clinical assessment, such as malalignment and range of motion impairment compared to the contralateral side. Patient-reported outcome questionnaires are collected at specific follow-ups, including 3–8 weeks, 3 months, 6 months, 12 months, and 24 months to assess quality of life, functional health status, and pain.

Results: To date, 832 of the target 1000 patients have been consented and enrolled from 17 sites across 12 countries. A total of 222 patients have been recruited across four Canadian sites where forearm arm fractures are most prevalent and femoral neck fracture and traumatic hip dislocation are the rarest ones. In July 2024, the goal of recruiting 200 participants across all centers was reached for supracondylar humerus fractures.

Conclusions: Moving forward, femoral neck fractures and hip dislocation injuries will be actively prioritized. The planned end of recruitment is for April 30, 2025 after which we will transition to data analysis.

Title: Exploring the Views and Experiences of Children with Limb Differences and Their Parents on Receiving a Representative Toy
Authors: Gael Hernandez Palmer, Diba Torjani, Dr. Harpreet Chhina, Dr. Anthony Cooper
Affiliations: BC Children's Hospital Department of Orthopaedic Surgery, UBC Department of Orthopaedics
Primary Supervisors: Dr. Harpreet Chhina, Dr. Anthony Cooper

Purpose:
Children with lower limb differences (LDs), such as leg length discrepancies (LLDs) or amputations, often face unique psychosocial challenges, including issues related to body image and self-concept. These challenges can impact their social interactions and emotional well-being. Previous studies have found disabled children to have positive attitudes towards toys representing disability. This study aims to explore the views and experiences of children with LDs and their parents receiving a toy representing LDs. Specifically, we investigate whether these toys can positively influence their self-concept, emotional well-being, and play.

Methods:
This mixed-methods study will recruit children aged 3-12 years with LDs (as defined above) and their parents from the BC Children's Orthopaedic Clinic. Participants will be provided with a representative toy of their choice—either "Lou," a cat with a LLD, or "Ziggy," an alligator with a missing lower limb. Data collection will include a pre-intervention survey and two post-intervention surveys at 3 and 6 months administered via REDCap to assess changes in psychosocial domains such as self-concept and emotional well-being. Additionally, semi-structured focus groups will be conducted with 5 parent-child pairs to gather qualitative insights into the children's and parents' experiences with the toys. Quantitative and thematic analyses will be undertaken to understand changes in the domains of interest and families' attitudes towards the toys.

Expected Results
We anticipate that the provision of a representative toy will improve participants' self-concept, body-image, and emotional well-being. We also expect parents may report positive attitudes towards the toys and in how their children engage in peer-play and discuss their limb differences. We hope the toys may foster a sense of normalcy and belonging among children with LDs and promote empathy and acceptance among their peers.

Significance:
This novel study will contribute valuable insights into the role of representative toys in supporting the psychosocial health of children with LDs. The findings could inform future interventions aimed at improving psychosocial well-being for this population and promoting diversity and inclusion in children's play environments.