Canadian Journal of Surgery
Journal canadien de chirurgie

Vol. 67 (6 Suppl 1) November 13, 2024
doi: 10.1503/cjs.011424

Canadian Spine Society

24th Annual Scientific Conference

Wednesday, February 28 – Saturday, March 2

Fairmont Chateau Whistler, Whistler, B.C., Canada

Abstracts

The Canadian Spine Society is a collaborative organization of spine surgeons advancing excellence in research, education and patient care.

Accreditation: This event is an Accredited Group Learning Activity (Section 1) as defined by the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada, approved by the Canadian Orthopaedic Association.

Course Background: The 2024 Annual Scientific Conference of the Canadian Spine Society (CSS) brings together leaders in spine care and spine surgery from across Canada and around the world. It is an exceptional venue for promoting professional contact between spine specialists. The Conference enables and encourages participants to share ideas, solve mutual problems, exchange research proposals and promote multidisciplinary innovation. Indicative of its scope, the program will be held in conjunction with the Canadian Paediatric Spine Society (CPSS), enabling a range of adult and pediatric didactic presentations, group discussions, case studies, symposia and research reviews. This year, a major focus will be spinal deformity. Dr. Christopher Shaffrey, an internationally renowned deformity surgeon, will deliver the keynote presentation, while an interactive symposium will tackle the problem of transitioning care from the pediatric to the adult patient. Other symposia will address updates in managing spinal trauma, Enhanced Recovery After Surgery (ERAS) in pediatric spine surgery and current concepts for dealing with surgical complications, including how to talk to a patient who has had a bad outcome. A recurring highlight of the meeting is the series of expert debates. Leading clinicians will defend opposing views on adding fusion to a cervical laminectomy, the need for anterior column reconstruction after metastasis excision, and what constitutes value-based surgery. Spine surgeons new to their practices will have sessions tailored to practice development, stressing the pearls and pitfalls of the early years. Spine fellows and residents will join experienced spine surgeons in evaluating the clinical decisions that led to successful operative outcomes. Women in Spine Surgery (WISE) is now a regular feature of the Conference. The Canadian Spine Outcomes and Research Network (CSORN) will meet to review ongoing research and propose new initiatives. E-posters will be displayed throughout the meeting for easy viewing, and dedicated poster review sessions will give authors and attendees the opportunity to interact. The meeting design fosters comfortable, extended contact with the exhibitors, allowing spine surgeons to handle new equipment and discuss concerns with industry representatives free from intrusive marketing. The CSS Scientific Conference continues to be the best way to add to your clinical knowledge, stay up to date with changes in spine surgery, establish and renew professional contacts, and remain involved with spine care in Canada.

ABSTRACTS FOR PRESENTATION — PODIUM SECTION

CPSS-01
Abstract ID 48

Is long-term follow-up required for low-grade spondylolisthesis? A prospective study of 247 children followed until skeletal maturity. ***Antoine Dionne,[1,2] Majeed Al-Zakri,[3] Hubert Labelle,[1,3] Julie Joncas,[3] Stefan Parent,[1,3] Jean-Marc Mac-Thiong.[1,2,3]*** **From the [1]Université de Montréal, Montréal, Que.; the [2]Centre de Recherche de l'Hôpital du Sacré-Cœur de Montréal, Montréal, Que.; the [3]Centre Hospitalier Universitaire Sainte-Justine, Montréal, Que.**

Background: Low-grade spondylolisthesis is a common spine diagnosis, but there is no large prospective study pertaining to its natural history. Consequently, there are still no guidelines on the requirements for follow-up in this population, and most clinicians will follow patients until skeletal maturity to ensure that there is no slip progression or development of neurological deficits that would require surgery. The objective of this longitudinal study was to document the clinical/radiological changes observed from initial presentation to skeletal maturity for low-grade spondylolisthesis in children. **Methods:** A prospective observational cohort of 247 children referred to a single pediatric clinic for low-grade isthmic spondylolisthesis was followed for a minimum of 2 years until they reached a Risser stage of at least 4. There were 108 boys and 139 girls with a mean age of 13.0 years (standard deviation [SD] 2.7 yr) at initial presentation and a mean follow-up duration of 4.7 (SD 2.3) years. The percentage of slip was assessed from x-rays, and pain was measured using the SRS-22r (Scoliosis Research Society) outcome questionnaire. **Results:** The initial percentage of slip was 14.8% (SD 9.0%) (maximum 49%). There were 4 patients with a slip percentage between 40% and 50% that remained unchanged at final follow-up. Slip progression by at least 10% was observed in 7 children (2.8%), but these patients had a slip percentage less than 40% at final follow-up. There was no evidence of neurological deterioration. A small proportion of patients (19%) had worsened pain (≥ 0.5 decrease in SRS-22r pain subscore) at final follow-up. Surgery was performed in 2 patients for persisting axial pain after failed conservative treatment. **Conclusion:** Progression of low-grade isthmic spondylolisthesis is unlikely during growth. Progression to a high-grade slip or development of neurological deficit was not observed in our cohort. While 19% of patients had worsened pain at final follow-up, surgery is rarely necessary for intractable pain despite conservative management. Although short-term follow-up can be advised to rule out rapid progression of spondylolisthesis, this study suggests that long-term follow-up until skeletal maturity is unnecessary in the majority of cases.

CPSS-02
Abstract ID 101

Major complications following anterior vertebral body tethering surgery. ***Firoz Miyanji,[1] Baron Lonner,[2] Ali Eren,[1] Patrick Cahill,[3] Stefan Parent,[4] Peter Newton.[5]*** **From [1]BCCH, Vancouver, B.C.; [2]Mount Sinai, New York, N.Y.; [3]CHOP, Philadelphia, Pa.; [4]St. Justine's Hospital, Montréal, Que.; the [5]Rady Children's Hospital, San Diego, Calif.**

Background: The aim of this study was to report on complications following anterior vertebral body tethering (AVBT) surgery for the treatment of adolescent idiopathic scoliosis (AIS). **Methods:** A retrospective multicentre database identified consecutive patients with AIS who were treated with AVBT surgery from 2011 to 2019. Patients with ≥ 2-yr follow-up were included for analysis. All peri- and postoperative complication data following surgery were collected. Those requiring revision surgery or unplanned invasive interventions were considered major complications, while all others

were deemed as minor. **Results:** In this series of 328 patients the major complication rate was 22%, and minor complications were noted in 29% of patients. Fifty-eight patients had 67 various reoperations (26 [7.9%] posterior spinal fusion [PSF]), 37 [11.3%] tether release/removal/replacement, 1 [0.3%] wound infection and 3 [0.9%] dural tears). Five patients had unplanned interventions for respiratory concerns (pneumothorax/hemothorax/effusion [0.6%] or shortness of breath [0.9%]). Radiographic complications of overcorrection > 10° (7.6%), new compensatory curve/adding-on (4%), loss of correction/progression of primary curve (5.5%) and other (4.6%) were seen in 61 patients. Eighty percent of overcorrected curves were either revised to PSF (0.6%) or had tether revision (5.5%). New compensatory curve/adding-on resulted in revision surgery in 12 patients (PSF in 1.5% and tether extension 2.1%). Loss of correction/progression of primary curve without suspected tether breakage was noted in 4 patients (1.2%), all of whom received revision to PSF. Suspected broken tether was the highest reported complication (23% of patients); however, only 7% had revision surgery (PSF in 3.4% and tether replacement in 3.7%). Pulmonary issues were reported in 21 patients: 2 required chest tube reinsertion, 1 reintubation, and 2 ICU admission for bilevel positive airway pressure therapy. Minor complications included 51 (15.5%) broken tethers without revision surgery, transient right upper extremity numbness in 1 patient (0.3%), postoperative pain (back/shoulder/other) in 8 (2.4%) and mild gastrointestinal symptoms in 3 (0.9%). **Conclusion:** The major complication rate following AVBT was noted to be 22% at ≥ 2-year follow-up. Revision AVBT is more likely than conversion to PSF owing to the high overcorrection rate.

CPSS-03
Abstract ID 164

Late referral of adolescent idiopathic scoliosis: the impact of socioeconomic status and health care utilization. ***Jennifer A. Dermott,[1,2] Liisa Jaakkimainen,[3,4] Teresa To,[5,3] Maryse Bouchard,[1] Andrew Howard,[1,3] David E. Lebel.[1]*** **The [1]Hospital for Sick Children, Toronto, Ont.; the [2]University of Toronto, Toronto, Ont.; [3]ICES, Toronto, Ont.; the [4]Sunnybrook Research Institute, Toronto, Ont.; the [5]SickKids Research Institute, Toronto, Ont.**

Background: Brace treatment minimizes the risk of scoliosis curve progression to surgical range; however, most adolescent patients with idiopathic scoliosis (AIS) present too late to be considered an ideal brace candidate. The purpose of this study was to examine socioeconomic status (SES) and public health care utilization trends that may be associated with late AIS referral to a specialist, ultimately contributing to a higher than necessary surgical burden. **Methods:** Information for all patients aged 10–18 years with AIS seen for initial consultation within a tertiary care spine program between Jan. 1, 2014, and Dec. 31, 2021, was linked to provincial health administrative databases. Linked data included age, sex, body mass index (BMI), Cobb angle and Risser stage. Income and material deprivation quintiles based on geographic area of residence and individual-level data pertaining to immigration status were proxies for SES. Utilization of health services in the 5 years prior to first specialist visit was represented by rate of physician outpatient visits stratified by specialty and annual health examinations. A comparative analysis was conducted between youth referred late/not late, and variables that increased the probability of late referral were evaluated, with significance set at $p < 0.001$. **Results:** In total, 2732 patients with AIS (2236 [82%] female) were seen in the study period. The average age (± standard deviation) was 14.1 (± 1.7) years (range 10.0–17.9 yr), mean Cobb angle 37.6° (± 14.4°) (range 10°–95°) and mean BMI 20.4 (± 5.2) (range 12.2–54.5). The percentage of late referrals was 27% ($n = 728$). Late referral was associated with younger age at presentation (13.8 yr v. 14.2 yr), less mature Risser stage and fewer physician outpatient visits (16.2 v. 18.7). The probability of being referred late increased with lower income (Q1 = 0.32 v. Q5 = 0.23) and higher level of material deprivation (Q5 = 0.3 4 v. Q1 = 0.22), and decreased when a pediatrician was the primary care provider (0.13 v. 0.35) or with regular annual health examinations (0.11 v. 0.32). **Conclusion:** Both lower SES and health care utilization increased the probability of late AIS referral, particularly when care was not provided by a pediatrician or when annual health examinations were infrequent.

CPSS-04
Abstract ID 97

The impact of curve correction on patient satisfaction — Is straighter better? ***Sarah Hardy,[1,2] Armaan K. Malhotra,[2,3] Jennifer Dermott,[2] Dilani Thevarajah,[2] Karen D.A. Mathias,[2] Samuel Yoon,[2,3] Rajendra Sakhrekar,[2] David E. Lebel.[2,3]*** **From the [1]University of Waterloo, Waterloo, Ont.; the [2]Hospital for Sick Children, Toronto, Ont.; the [3]University of Toronto, Toronto, Ont.**

Background: The impact of curve correction on patient satisfaction in adolescent patients with idiopathic scoliosis (AIS) after posterior spinal fusion (PSF) remains unclear. To optimize correction, some surgeons may consider higher-risk surgical techniques. To ensure surgical decision-making is made in the best interest of the patient, it is essential to understand the association between patient satisfaction and curve correction. The aim of this study was to determine the patient and surgical factors most related to satisfaction in patients with AIS who have undergone PSF, with a focus on the impact of curve correction. **Methods:** Patients with AIS who had completed a pre- and postoperative Scoliosis Research Society (SRS) questionnaire ≥ 1 year after surgery were included. The mean differences between pre- and postoperative scores were assessed using either paired 2-sample *t* tests or the Wilcoxon rank sum test and considered with respect to minimal clinically important difference. Associations between SRS questionnaire scores and covariates were assessed using linear regression models. **Results:** Of the 95 patients included (mean age 15.1 yr, 86.3% female), 73 completed sufficient baseline and follow-up items to consider their total SRS score. Total and all-domain SRS scores, except function, showed statistically significant improvement after PSF. Univariate regression revealed associations between complications ($p = 0.046$) and male sex ($p = 0.020$) with decreasing satisfaction scores, and between percent correction ($p = 0.001$) and change in sagittal vertical axis ($p = 0.048$) with increasing self-image scores. After multivariable adjustment, male sex was associated with reduced satisfaction scores ($p = 0.030$), and increasing percent correction was associated with improvement in self-image scores ($p = 0.004$), with an effect size of 0.021. No relationship between percent correction

and satisfaction was found. **Conclusion:** Improvement in total score, pain, self-image, mental health and satisfaction was statistically significant; however, clinical significance was exclusively achieved in the pain and self-image domains. Greater correction was only associated with higher self-image scores, with our results suggesting 47% correction produces meaningful improvement. These findings suggest cosmesis may be a concern for patients with AIS and should be considered during preoperative planning.

CPSS-05
Abstract ID 22

Assessing Cobb angle agreement in community spine radiographs: clinical significance in adolescent idiopathic scoliosis patients. ***Dorothy J. Kim,[1] Ayesha Hadi,[1] Andrea Doria,[1] Aya Mitani,[2] Jennifer Dermott,[1] Andrew Howard,[1] David Lebel.[1]*** **From the [1]Hospital for Sick Children, Toronto, Ont.; the [2]University of Toronto, Toronto, Ont.**

Background: The study objectives were 1) to determine the agreement of Cobb angle readings between index evaluation of community spine x-ray and re-evaluation of the same image by spine specialist and pediatric radiologist, and 2) to determine if inaccuracies were associated with late adolescent idiopathic scoliosis (AIS) referrals (i.e., those presenting as likely surgical candidates at initial visit). **Methods:** A review of patients with AIS (n = 170) seen for initial visit at a tertiary care pediatric hospital between January and September 2021 was conducted. Community index spine x-rays available on the institution's picture archiving and communication system (n = 119) were independently measured by 2 blinded raters. Agreement in Cobb angle readings and corresponding Scoliosis Research Society management categories between community radiology and tertiary care clinicians was measured using the intraclass correlation coefficient (ICC) and Fleiss' κ statistic. Agreement for evaluation of the reference standard 3-foot standing spine x-ray was also measured. Logistic regression was used to estimate the odds of late referral from the discrepancy in Cobb angle measurements between community radiology and reference standard when images were obtained within 90 days of each other (n = 111). Discrepancies were defined as differences in Cobb angle measurements > 5°. **Results:** Most index x-rays (72.6%) were obtained at a private community clinic. The agreement in Cobb angle on the index x-ray between community radiologist and spine specialist was fair (ICC 0.78, 95% confidence interval [CI] 0.66–0.86, standard error of the mean [SEM] 6.14°), with moderate agreement in corresponding management (κ = 0.58). On the same image, the agreement between community radiologist and pediatric radiologist remained fair (ICC 0.74, 95% CI 0.65–0.81, SEM 6.73°), although agreement in corresponding management improved (κ = 0.65). Agreement between spine specialist and pediatric radiologist on both index (ICC 0.96, 95% CI 0.89–0.98, SEM 2.57°) and reference standard (ICC 0.97, 95% CI 0.95–0.98, SEM 2.86°) was excellent, with substantial agreement in corresponding management (κ = 0.73 and 0.71, respectively). The proportion of patients with discrepancies in Cobb angle measurements was 45.0%. The odds of late referral increased with inaccuracies in community measurements (odds ratio 3.52, 95% CI 1.90–6.53). **Conclusion:** Inaccuracies in community radiology impact timely referral, contributing to missed opportunities for bracing and subsequently increasing surgical burden.

CPSS-06
Abstract ID 35

Enhanced Recovery After Surgery does not affect incidence of chronic postsurgical pain and improves postoperative outcomes after pediatric spine surgery. ***Samuel Yoon,[1,2] Karen Mathias,[1] Jennifer Dermott,[1] David Lebel.[1]*** **From the [1]SickKids Hospital, Toronto, Ont.; the [2]Royal Children's Hospital, Melbourne, Victoria, Australia.**

Background: Enhanced Recovery After Surgery (ERAS) protocol has gained traction in various surgical disciplines, including pediatric spinal surgery. ERAS protocol reduces short-term postoperative opioid consumption, improves pain and decreases length of stay without an increase in complications. However, the long-term effects of ERAS protocol after pediatric spine surgery remain unclear. This investigation sought to determine whether the implementation of an ERAS pathway affected the incidence of chronic postsurgical pain after posterior spinal fusion (PSF). **Methods:** A retrospective, case–control study was conducted of patients undergoing PSF for adolescent idiopathic scoliosis at a tertiary pediatric centre. Demographic and surgical data, and participation in individual components of the ERAS pathway were recorded. Scoliosis Research Society-22 (SRS-22r) questionnaire values at baseline and 3 and 12 months postoperatively between patients treated with the ERAS protocol and those who were not were compared. **Results:** One-hundred forty-six patients met inclusion criteria. There were 67 patients in the ERAS group and 79 in the non-ERAS group. The groups were matched in demographics, preoperative Cobb angle and number of intervertebral levels fused. Patients treated with ERAS had shorter hospital stays (3.1 d ± 1.2 d versus 4.9 d ± 2.6 d, p < 0.001). The non-ERAS group had greater percentage of Cobb angle correction (75.0% ± 11.5%) and a smaller postoperative Cobb angle (18.1° ± 9.7) than the ERAS group (68.4% ± 11.6%, p < 0.001, and 22.1° ± 8.7°, p = 0.009, respectively). While the SRS-22r pain domain scores significantly improved from baseline to 3 months postoperatively, there were no differences in pain scores at baseline, 3 months or 12 months postoperatively between the ERAS and non-ERAS groups. Further analysis revealed only ERAS patients reported improved self-image at 12 months compared to 3 months postoperatively (p = 0.009). No differences in self-image were reported in the non-ERAS group over time (p = 0.831). Additionally, regardless of time since surgery, ERAS patients had significantly better function (p = 0.026). **Conclusion:** Perioperative management through an ERAS protocol does not affect pain up to 1 year after surgery. Treatment through ERAS resulted in shorter length of stay. There may be long-term benefits in self-image and function for patients treated with ERAS.

CPSS-07
Abstract ID 102

Predicting overcorrection in anterior vertebral body tethering: Can we improve patient selection? ***Firoz Miyanji,[1] Peter Newton,[2] Baron Lonner,[3] Tracey Bastrom,[2] Amer Samdani.[4]*** **From [1]BCCH, Vancouver, B.C.; the [2]Rady Children's Hospital, San Diego, Calif.; [3]Mount Sinai, New York, N.Y.; the [4]Shriners Children's Philadelphia, Philadelphia, Pa.**

Background: The high complication profile and revision surgery rate in anterior vertebral body tethering (AVBT) due to overcorrection suggests a better understanding of patient selection is needed. Our aim was to determine variables that were associated with overcorrection and secondarily to identify predictors of overcorrection in patients treated with AVBT. **Methods:** A multicentre AVBT database identified consecutive patients with ≥ 2-yr follow-up. Preoperative, first erect (FE) and most recent follow-up (MRF) x-rays were measured by an independent reviewer. Patients were divided into 2 groups: overcorrection group (OCG), defined as ≥ 10° of primary tethered Cobb in opposite direction at MRF, and nonovercorrection group (NOCG), having no radiographic complication or revision procedure by MRF. Univariate analysis explored the association between overcorrection and variables of interest, and multivariate regression analysis identified potential predictors of overcorrection. **Results:** A total of 253 patients with mean follow-up duration of 38 (range 24–102) months were analyzed. Twenty-two patients (8.7%) were overcorrected, with 10 (45.5%) requiring revision surgery. There was no statistically significant difference in the preoperative primary coronal Cobb value ($p = 0.11$), flexibility ($p = 0.054$) or sex distribution ($p = 0.22$) between the groups. The OCG had significantly smaller curves on FE x-ray ($p = 0.007$), were younger by a mean of 1.5 years ($p < 0.001$) and were shorter on average by 9.3 cm ($p < 0.001$). A significant proportion of patients in the OCG were Risser stage 0 (95%), compared to 58.6% in the NOCG ($p < 0.001$). On average, there were significantly more patients with open triradiate cartilage in the OCG than in the NOCG ($p = 0.023$). Significantly more patients in the OCG than in the NOCG were Sanders stage < 3 (40% v. 7.4%, $p < 0.001$). Regression analysis identified Risser stage 0 ($p = 0.038$), FE Cobb angle ($p = 0.001$) and preoperative height ($p < 0.001$) to be predictors of overcorrection, with Risser stage 0 patients having an 11.6-fold greater chance of overcorrection. Every degree improvement in FE Cobb angle increased the rate of overcorrection by 17.4%; for every centimetre decrease in preoperative height the overcorrection rate increased by 16.6%. **Conclusion:** We found Risser stage 0, smaller FE Cobb angle and shorter preoperative height to be predictors of overcorrection following AVBT. Although AVBT has shown efficacy in skeletally immature patients, patients who are too immature with significant initial curve correction are at heightened risk of overcorrection.

CPSS-08
Abstract ID 66

New artificial intelligence–driven surface topography phone app helps screen patients with spinal deformity: early results from one institution. ***Marjolaine Roy-Beaudry, Marie Beauséjour, Rachelle Imbeault, Justin Dufresne, Stefan Parent*****. From CHU Sainte-Justine, Montréal, Que.**

Background: Radiation-free techniques such as scoliometry, spinal ultrasonography and Moiré topography have had limited success in screening and monitoring patients with adolescent idiopathic scoliosis (AIS). The purpose of such modalities was to decrease serial spinal x-rays. A new digital health app leverages advanced 3D surface topography technology coupled with artificial intelligence (AI) to predict scoliotic Cobb angles. The objective of this study was to validate the accuracy and reliability of this technology. **Methods:** A single-centre observational study was conducted in the outpatient scoliosis clinic. One hundred and twenty-five patients with confirmed or suspected scoliosis were recruited. Once consent was obtained, two 3D surface topography scans (upright and bent forward positions) were performed on an Apple iPhone 12. Demographic and radiological parameters were collected to determine their influence on the validity of the automated measurement. Validity and reproducibility of the app's Cobb angle predictions were compared to radiographic measurements. **Results:** Twenty poor-quality scans were discarded. Of the remaining 105 patients, 79 were randomly assigned to the training set, and the scans of 26 were used to validate the algorithm. To normalize the distribution of the validation set, 12 additional control patients were added to the validation set, for a total of 38 patients. The algorithm predicted Cobb angle (below 50°) with overall correlation of 0.89 and mean average error of 6.2°. The app screened for AIS (10° threshold) with a sensitivity of 0.92, specificity of 0.75 and area under the curve (AUC) of 0.94. At 25°, the threshold for the initiation of brace interventions, a sensitivity of 0.71, specificity of 0.90 and angle under the curve of 0.97 were noted; at 50° (surgical threshold), the values were 0.50, 1.00 and 0.94, respectively. **Conclusion:** The implementation of 3D topography combined with AI seems of improve the accuracy of classic surface topography to predict scoliotic Cobb angle. The app's availability on smartphones facilitates frequent at-home remote monitoring of scoliotic deformities to avoid unnecessary hospital visits and spinal x-rays, potentially detecting early curve progression as well.

CPSS-09
Abstract ID 96

Postoperative suicide risk is elevated in patients undergoing posterior spinal instrumentation and fusion. ***Jessica Romeo,[1] Holly Livock,[2] Kevin Smit,[2] James Jarvis,[2] Andrew Tice.[2]*** **From The Children's Hospital of Eastern Ontario, Ottawa, Ont.**

Background: Mental health concerns have been well documented in adolescents, and studies have highlighted the increased prevalence in patients with spinal deformity. Patients with large curves are at highest risk of requiring mental health support, especially postoperatively. Limited literature exists on patients with surgical magnitude curves and suicide risk. The Ask Suicide-Screening Questions (ASQ) tool is an instrument to identify at-risk youth. It has been implemented at our institution since 2019 in patients over age 12 years admitted for any reason. The study objective was to determine the incidence and risk factors of positive ASQ screening findings in patients undergoing posterior spinal fusion (PSF). **Methods:** Participants were retrospectively collected from a single-centre tertiary hospital. Patients diagnosed with a spine condition who had had PSF between 2019 and 2023, were aged 12–20 years and had completed the ASQ postoperatively were included. Data such as demographics, medical history, surgical characteristics, length of stay and preoperative HEADSS (home, education, activities/employment, drugs, suicidality and sex) assessment were collected from the patient's electronic chart. Positive ASQ findings were identified and compared to the negative screening group. **Results:** A total of 102 patients completed the ASQ tool following PSF, with 21 patients (21%) screening

positive. Average age at surgery was 14.9 years, and 75% of patients were female. There were 25 patients with a preoperative mental health diagnosis, which increased the incidence of a positive ASQ screen (odds ratio [OR] 9.12, 95% confidence interval [CI] 2.72–33.86, $p \leq 0.001$). A positive preoperative HEADSS assessment was also associated with having a positive ASQ result (OR 4.93, 95% CI 0.77–32.13, $p = 0.05$). **Conclusion:** Twenty-one percent of patients undergoing PSF had a positive ASQ screen, indicating the high incidence of suicidal risk in this patient population. Patients with a preoperative mental health diagnosis were at highest risk of screening positive. This initiative also identified a population of at-risk adolescents who access the medical system for targeted needs outside of a mental health origin. There is an opportunity to improve preoperative mental health screening in adolescents undergoing spinal surgery to optimize their postoperative mental health.

CPSS-10
Abstract ID 53

Characterizing antibiotic prophylaxis practices in pediatric deformity spinal surgery and impact on 30-day postoperative infection: an NSQIP pediatric database study. ***Vivien K. Chan,[1] Robert Cho,[2] Selina Poon,[2] David L. Skaggs,[3] Geoffrey K. Shumilak.[4]*** **From [1]UCLA, Los Angeles, Calif.; [2]Shriners Children's Southern California, Los Angeles, Calif.; the [3]Cedars-Sinai Medical Center, Los Angeles, Calif.; the [4]University of Saskatchewan, Saskatoon, Sask.**

Background: Postoperative infection after spinal deformity correction in pediatric patients is associated with significant morbidity. Antibiotic prophylaxis is widely used in surgical specialties to reduce the rate of infection. The objective of this study was to characterize antibiotic prophylaxis practices in pediatric patients who have received posterior arthrodesis for spinal deformity and to understand how these practices impact 30-day postoperative infection rates. **Methods:** This was a retrospective cohort study using the American College of Surgeons NSQIP (National Surgical Quality Improvement Program) pediatric database for 2021. Patients were included if they had received posterior arthrodesis for scoliosis or kyphosis correction. The outcome of interest was 30-day postoperative infection. Descriptive statistics were used to describe demographics and outcomes. Fisher's exact test was used to analyze the impact of intravenous antibiotic prophylaxis, intraoperative intravenous antibiotic redosing after 4 hours, postoperative antibiotic prophylaxis and intraoperative topical antibiotics on 30-day postoperative infection. The effectiveness of various antibiotic prophylaxis regimens was compared using Fisher's exact test. **Results:** A total of 6974 patients were included in this study. The mean age was 13.8 years, and 66.7% were female. The 30-day infection rate was 2.9%. Presurgical intravenous antibiotic prophylaxis was used in 89.8% of patients and was associated with a significantly reduced infection rate (11.5% v. 2.7%, $p < 0.01$). Postoperative antibiotic prophylaxis was used in 81.4% of patients and was associated with a reduced infection rate (5.7% v. 2.4%, $p < 0.01$). Intraoperative topical antibiotics were used in 84.6% of patients and were associated with a reduced infection rate (4.0% v. 2.7%, $p = 0.019$). In patients who received gram-positive antimicrobial coverage, there was no significant difference in infection rates between patients who received cefazolin versus vancomycin versus clindamycin. The addition of gram-negative coverage to gram-positive coverage did not result in significant differences in infection rates. **Conclusion:** We found the use of presurgical intravenous antibiotics, postoperative intravenous antibiotics and intraoperative topical antibiotics to significantly reduce infection rates. Broad-spectrum coverage did not result in reduced infection rates. Results from this study can be applied to future research on implementation of standardized infection prevention protocols.

A-11
Abstract ID 16

Preoperative opioid use affects self-reported pain scores in elderly patients undergoing multilevel spinal surgery for adult spinal deformity. ***Brett Rocos,[1] Juan P. Sardi,[2] Anastasios Charalampidis,[3] Jeff Gum,[4] Stephen J. Lewis.[5]*** **The [1]Duke University Hospital, Durham, NC; the [2]University of Virginia, Charlottesville, VA; the [3]Karolinska Institute, Stockholm, Stockholm, Sweden; [4]Norton Healthcare, Louisville, KY; the [5]Toronto Western Hospital, Toronto, Ont.**

Background: The purpose of this study was to assess and compare patient-reported pain outcomes in older patients undergoing spinal deformity surgery, with the hypothesis being that preoperative opioid use affects self-reported postoperative pain scores in elderly patients undergoing this complex procedure. **Methods:** Patients ≥ 60 years of age from 12 centres undergoing spinal fusion ≥ 5 levels for spinal deformity were included. Patients completed a numeric rating scale (NRS) for both back and leg pain. Opioid use was identified from prescriptions and question 11 of the Scoliosis Research Society-22 (SRS-22r) questionnaire. The patient-reported outcome scores at 2 years were compared to baseline. **Results:** A total of 219 patients were included. There were 176 females (80.4%), and the mean age was 67.5 years. Seventy-five patients (34%) reported opioid use preoperatively, of whom 63 reported an NRS score for back pain and 61 reported an NRS score for leg pain at 2 years. Of the 144 patients who denied opioid use at baseline, 114 reported an NRS score for back pain and 113 an NRS score for leg pain at 2 years. The baseline back pain NRS score was 7.0 (SD 2.0) in the opioid group and 5.7 (2.8) in the non-opioid group ($p = 0.001$). The baseline NRS score for leg pain was 4.8 (3.4) in the opioid group and 4.0 (3.3) in the non-opioid group ($p = 0.159$). At 2 years, the NRS score for back pain was 3.2 (2.5) in the opioid group and 2.3 (2.6) in the non-opioid group ($p = 0.012$), while the NRS score for leg pain was 2.2 in the opioid group and 2.4 in the non-opioid group ($p = 0.63$). At 2 years, 39.1% (25/64 patients) of the opioid group were no longer taking opioids, while 16/115 patients (13.9%) in the non-opioid group reported taking opioids. **Conclusion:** Patients on opioids had significantly more pain at baseline that persisted to 2 years follow-up. Both the opioid and non-opioid groups benefitted from the surgery, as indicated by improvements in the NRS scores at 2 years. Close to 40% of opioid users no longer required them at 2 years.

A-12
Abstract ID 41

The impact of a perioperative Enhanced Recovery After Surgery program on outcomes in adult cervical deformity patients. ***Peter S. Tretiakov,[1] Oluwatobi Onafowokan,[1] Jamshaid Mir,[1] Ankita Das,[1] Tyler Williamson,[1] Pooja Dave,[1] Bailey Imbo,[1] Jordan Lebovic,[1] Pawel Jankowski,[2] Peter G. Passias.[1]*** **From [1]NYU Langone Health, New York, N.Y.; the [2]Hoag Neurosciences Institute, Newport Beach, Calif.**

Background: Enhanced Recovery After Surgery (ERAS) can help accelerate patient recovery and assist hospitals in maximizing the incentives of bundled payment models while maintaining high-quality patient care. A key ERAS component is the ability to predictably reduce inpatient length of stay and reduce postoperative opioid use and complications. Our objective was to assess the impact of ERAS protocols on the perioperative course in adult cervical deformity (ACD) corrective surgery. **Methods:** Operative ACD patients aged ≥ 18 years with complete preoperative and up to 2 years postoperative radiographic/HRQL (health-related quality of life) data were stratified by enrolment in the ERAS protocol beginning in 2020. Differences in demographics, clinical outcomes, radiographic alignment targets, perioperative factors and complication rates were assessed by means of comparison analysis. **Results:** In all, 220 patients were included (mean age 58.11 yr ± 11.97 yr, 48% female, mean body mass index 29.13 ± 6.89). Fifty-four patients (25.0%) received ERAS protocol recovery treatment perioperatively. At baseline, ERAS+ patients had significantly higher Neck Disability Index ($p = 0.005$) and EuroQol-5D (EQ-5D) ($p = 0.023$) scores, and significantly lower mJOA (modified Japanese Orthopaedic Association) scores ($p < 0.001$). At baseline, ERAS– patients were significantly more likely to utilize opioids than ERAS+ patients ($p = 0.016$). Perioperatively, ERAS+ patients had significantly lower operative times overall, and, if staged, a significantly lower mean stage 1 operative time (both $p < 0.021$). ERAS+ patients had significantly lower estimated blood loss overall (583.4 mL v. 246.51 mL, $p < 0.001$) and required significantly lower doses of propofol intraoperatively than ERAS– patients ($p = 0.020$). ERAS+ patients also reported lower mean length of stay overall (4.33 d v. 5.84 d, $p = 0.393$) and were more likely to be discharged directly to home ($\chi^2_1 = 4.974$, $p = 0.028$). ERAS+ patients were less likely to require steroids after surgery ($p = 0.045$), to develop neuromuscular complications overall ($p = 0.025$), and to experience venous complications or be diagnosed with venous disease postoperatively ($p = 0.025$). **Conclusion:** ERAS programs in ACD surgery demonstrate significant benefit in perioperative outcomes. Patients receiving ERAS-based protocols experience lower operative times, length of stay, rates of opioid use, anesthetic dosage and postoperative complications. For ERAS-eligible patients, such programs may improve clinical outcomes and reduce cost burden for both hospitals and patients alike.

A-13
Abstract ID 112

A prospective, observational, multicentre study assessing functional improvements after multilevel fusion for adult spinal deformity: 5-year follow-up results. ***Stephen Lewis,[1] Yousef Aljamaan,[1] Lawrence G. Lenke,[2] Justin Smith.[3]*** **From the [1]University of Toronto, Toronto, Ont.; [2]Columbia University, New York, N.Y.; the [3]University of Virginia, Charlottesville, Va.**

Background: Our objectives were to assess which key functional outcomes, including standing, walking and sitting, were most impacted by multilevel fusion surgery for adult spinal deformity (ASD) and to assess if these functional improvements were maintained over the follow-up period. **Methods:** Patients ≥ 60 years of age from 12 international centres undergoing spinal fusion of > 5 levels were included. Follow-up visits were conducted at 10 weeks, 12 months, 24 months and 60 months. Function was assessed using the Scoliosis Research Society-22r (SRS-22r) function domain, and with the personal care, walking, sitting and standing sections from the Oswestry Disability Index (ODI) and 3-level EuroQol-5D (EQ-5D-3L) scores. **Results:** A total of 219 patients (80.4% females) were included; the mean age was 67.5 years. The mean preoperative SRS-22r function scores was 2.71 (95% confidence interval [CI] 2.61–2.80), which improved to 3.46 (95% CI 3.35–3.57) by 2 years after surgery and was sustained at 5 years (3.40, 95% CI 3.27–3.53). Almost half (44.9%) of patients were either bed-bound or had primarily no activity before the surgery; this was reduced to 18.1% at 2 years and 17.1% at 5 years. Similarly, the percentage of patients who could stand > 30 minutes improved from 24.3% to 67.8% at 2 years and 59.0% at 5 years. One-quarter (25.7%) of patients could walk for a mile or more before surgery, which improved to 62.7% at 2 years and 57.3% at 5 years; 42.6% had unlimited sitting preoperatively, which improved to 65.0% at 2 years and 64.2% at 5 years. Normal social life was seen in 18.8% of patients at baseline, compared to 56.0% at 2 years and 50.4% at 5 years. **Conclusion:** This study provides quantifiable information regarding practical functional improvements seen in patients ≥ 60 years of age undergoing multilevel spinal fusion for ASD. Specifically, at 5 years postoperatively, about 60% of patients can expect to stand more than 30 minutes, walk more than a mile and enjoy unlimited sitting, while 50% can enjoy a normal social life.

A-14
Abstract ID 19

Outcomes of preemptive spinal cord stimulation for patients with pain from structural spine deformities. ***Vishal P. Varshney,[1,2] Ramesh Sahjpaul,[1,2,3] Scott Paquette,[1,2,3] Jill Osborn.[1,2]*** **From the [1]Department of Anesthesia, Providence Health Care, Vancouver, B.C.; the [2]Department of Anesthesiology, Pharmacology and Therapeutics, University of British Columbia, Vancouver, B.C.; the [3]Department of Surgery, University of British Columbia, Vancouver, B.C.**

Background: Spinal column deformities such as kyphosis, coronal plane deformities or rotoscoliosis are often managed surgically with major spinal deformity correction procedures, which are associated with substantial immediate and delayed complication rates. In some patients, associated medical comorbidity may preclude the option of a deformity correction procedure. We postulated that there may be a role for preemptive spinal cord stimulation (SCS) in this challenging disease entity addressing axial spinal pain and/or radicular pain in a minimally invasive fashion and with a lower risk profile. We sought to develop a multidisciplinary management pathway for patients with low back pain, with or without radiculopathy, from structural spine deformities not amenable to or deemed too high a risk for a conventional deformity correction procedure, to

determine their candidacy for SCS. **Methods:** This is a prospective case series, with patient enrolment and patient-reported outcome measures (PROMs) analysis ongoing. Once patients have been deemed a candidate for trial of SCS, they undergo SCS trial with differential targeted multiplex stimulation for a period of 12 days. Our primary outcome measure is > 50% improvement in pain, as measured using standardized PROMs. PROMs will be collected every 6 months. **Results:** Five patients have been enrolled in this case series, with 3 patients (average age 71 yr, average Cobb angle 46.5°) having completed 6 month follow-up. The trial to implant ratio has thus far been 100%. Patients have demonstrated a 53% reduction in pain interference as measured on the PROMIS-29 (Patient-Reported Outcomes Measurement Information System) questionnaire between baseline and 6 months after implant, and have demonstrated a reduction in Pain Catastrophizing Scale score of 11 points ($p < 0.05$) at 6 months. **Conclusion:** Preemptive SCS may be a viable treatment option in the management of pain associated with structural spine deformities, perhaps mitigating the need for major deformity correction procedures.

A-15
Abstract ID 60

T1 pelvic and lumbar pelvic angles normative values: a prospective cohort study of 496 asymptomatic volunteers. ***Rémi Pelletier-Roy,[1] Michael Asmussen,[2] Manjot Birk,[1] Taryn Ludwig,[1] Fred Nicholls.[1]*** **From the [1]University of Calgary, Calgary, Alta.; the [2]Vancouver Island University, Nanaimo, B.C.**

Background: T1 pelvic angle (T1PA) and lumbar pelvic angle (LPA) have been introduced as sagittal spinopelvic parameters to guide assessment of adult spinal deformity (ASD). T1PA and LPA combine both sagittal and spinopelvic data and therefore are less exposed to patients' compensatory mechanisms. Suggested values for these parameters were derived from linear regressions based on Oswestry Disability Index scores from symptomatic patients having undergone surgery. While a few studies have evaluated the normative value of T1PA, none have evaluated the value of LPA in asymptomatic individuals. Our goal was to determine the normative values of LPA and T1PA in an asymptomatic cohort of volunteers. **Methods:** LPA and T1PA were measured on radiographs from a prospectively enrolled cohort of 496 asymptomatic individuals between 20 and 40 years old. LPA and T1PA were calculated as originally described from the centroid of L1 and T1, respectively, to the centre of the femoral head to the midpoint of the sacrum endplate. LPA and T1PA were also evaluated using the midpoint of the superior endpoint as a surrogate to the centroid of the vertebra to evaluate the similarity of these measurement techniques. **Results:** LPA and T1PA normative values were respectively 6.4° (95% confidence interval [CI] 0.0°–25.7°) and 7.3° (95% CI 0°–27.4°). There were no statistically significant or clinically measurable differences between using the centroids of L1 and T1 versus using the midpoint of the superior endplate, with respective results of 6.2° (95% CI 0.0°–24.9°) ($p = 0.42$) and 7.5° (95% CI 0.1°–27.7°) ($p = 0.54$). LPA was significantly different between Roussouly types 1, 2 and 3 versus type 4, with respective results of 3.5°, 4.8°, 5.9° and 9.3° ($p < 0.01$). The same difference was seen for the T1PA, with normative results of 5.9°, 6.7°, 6.5° and 9.1° ($p < 0.01$), respectively for Roussouly types 1, 2, 3 and 4. **Conclusion:** LPA and T1PA normative values are 6° and 7°, respectively, and vary between Roussouly morphotypes 1, 2 and 3 versus type 4. Using the midpoint of the superior endplate of L1 and T1 showed similar results and could be easier to use for clinicians and intraoperatively.

A-16
Abstract ID 128

How reliable are intraoperative neuromonitoring alerts during non-cord–level spinal deformity surgery? Results from the Spinal Deformity Intraoperative Monitoring study. ***Ariel Zohar,[1] Janneke Loomans,[2] Ferran Pellise,[3] Justin S. Smith,[4] So Kato,[5] Zeeshan Sardar,[6] Lawrence Lenke,[6] Stephen J. Lewis.[1]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]AO Foundation, Amsterdam, Netherlands; the [3]Vall d'Hebron University Hospital, Barcelona, Spain; the [4]University of Virginia, Charlottesville, Va.; the [5]University of Tokyo, Tokyo, Japan; [6]Columbia University, New York, N.Y.**

Background: The objective of this study was to assess the utility of intraoperative neurophysiological monitoring (IONM) in patients undergoing non-cord–level spinal deformity surgery. **Methods:** Twenty international centres prospectively documented IONM events, demographics, radiographic findings and surgical events of patients undergoing spinal deformity correction. Inclusion criteria were age 10–80 years, neurologically intact, major Cobb angle > 80° or undergoing any spinal osteotomy with electromyography (EMG), somatosensory evoked potentials (SSEP) and motor evoked potentials (MEP) monitoring. Detailed neurological examination was performed at baseline, immediately postoperatively and prior to discharge from hospital. IONM change was defined as amplitude loss of > 50% in SSEP or MEP from baseline or sustained EMG activity that lasted > 10 seconds. **Results:** Among the 197 patients, neuromonitoring alerts were observed in 22 (11.2%). No significant differences were found between the alert and no-alert groups in terms of age, sex, Cobb angles, deformity angular ratio, C7 plumb line, osteotomy, number of osteotomies or levels fused. A higher percentage of patients with a recorded alert were undergoing revision surgery compared to those with no alert (40.9% v. 18.9%, $p = 0.026$). Eighteen patients (81.8%) had 1 alert and 4 patients (18.2%) had 2. MEP alerts were the most common, observed in 21 of 26 alerts (80.8%), with 76.2% being unilateral and 23.8% being bilateral. In 61.5% of alerts, only MEP changes were seen. SSEPs were affected in 30.8% of alerts, and only SSEP changes were seen in 11.5% of alerts. EMGs were affected in only 7.7% of alerts. The majority (71.4%) of MEP changes fully recovered intraoperatively. Of the 197 patients, 33 (16.8%) developed new postoperative neurological deficits. Of these, 24 were not detected by IONM events during surgery. **Conclusion:** Overall, 16.8% of patients developed a new neurological deficit postoperatively. MEP alerts were most common, whereas EMG and SSEP were found unreliable. IONM alerts had high specificity (93.1%) and negative predictive value (86.1%). However, the sensitivity of IONM alerts was less than 50% for non-cord–level surgery.

A-17
Abstract ID 99

Using artificial intelligence to predict postoperative satisfaction for scoliosis patients: a retrospective database study. ***Aazad Abbas,[1] Jay Toor,[2] Gurjovan Sahi,[3] Dusan Kovacevic,[3] Johnathan Lex,[1] Firoz Miyanji.[4]*** **From the [1]Department of Orthopaedic Surgery, University of Toronto, Toronto, Ont.; the [2]Department of Orthopaedic Surgery, University of Manitoba, Winnipeg, Man.; the [3]Temerty Faculty of Medicine, University of Toronto, Toronto, Ont.; the [4]Department of Orthopaedics, University of British Columbia, Vancouver, B.C.**

Background: Scoliosis deformity has a large impact on the quality of life (QoL) of patients. However, the preoperative planning of scoliosis surgery that would result in best QoL outcomes has been controversial. Commonly debated parameters include upper instrumented vertebrae (UIV), lower instrumented vertebrae (LIV) and degree of correction, among others. Machine learning models (MLMs) have been used to predict outcomes using preoperative factors. The goal of this study was to predict the difference in pre- and postoperative Scoliosis Research Society-22 (SRS-22r) satisfaction scores at 2-year follow-up using MLMs constructed on preoperative factors. **Methods:** The Setting Scoliosis Straight database was queried for patients with scoliosis of Lenke 1 or 5 classification. Preoperative variables included demographic, radiographic and subjective variables. The data set was used to create 6 MLMs and a mean regressor. Five-fold cross validation was performed to identify the best model using mean squared error (MSE). Model accuracy was calculated by comparing the predicted SRS-22r score difference within a predesignated buffer of the actual score (buffer accuracy). The buffer represented the minimal clinically important difference for SRS-22r satisfaction. **Results:** A total of 1417 patients were included. The AdaBoost model had the best MSE during training (0.093), while the linear regression had the best MSE during testing (0.45). During testing, the random forest model had the best 0.25-buffer accuracy (35.2%), while AdaBoost had the best 0.5- and 1-buffer accuracy (79.9% and 94.4%, respectively). All models during training and testing performed better than the mean regressor across all accuracy metrics. The variables considered most important for the MLMs were age at diagnosis, pelvic tilt, Risser classification, pelvic incidence, C7-CSVL and Lenke modifier ($p < 0.001$). **Conclusion:** MLMs have been effectively implemented to accurately predict the difference in satisfaction scores for patients with scoliosis using preoperative factors. These results are powerful as they allow surgeons to use big data to accurately determine outcomes preoperatively and lay the groundwork for prescriptive models that generate recommended parameters such as UIV and LIV to maximize outcomes.

A-18
Abstract ID 70

A comparison of surgical outcome and equitable access for hip, knee and lumbar spine surgery for end-stage osteoarthritis. ***Raja Rampersaud,[1] Anthony V. Perruccio,[1] Nizar Mahomed,[1] Mayilee Canizares,[1] The CSORN Investigators.[2]*** **From the [1]Schroeder Arthritis Institute, University Health Network, Toronto, Ont.; the [2]Canadian Spine Society, Markdale, Ont.**

Background: Our objective was to compare health-related quality of life (HRQoL) before and 1 year after hip, knee and lumbar spine surgery for osteoarthritis (OA), and describe time trends in volume and rates of surgery for OA in Ontario. **Methods:** Data sources were the Canadian Spine Outcomes and Research Network (CSORN) registry (degenerative lumbar spondylolisthesis); Longitudinal Examination of Arthritis Pain, osteoarthritis (LEAP-OA) study (hip and knee OA); and Ontario Discharge Abstract Database (volume and rate of surgery). We compared the overall and age- and sex-specific physical component score (PCS) from the 12-Item Short Form Survey (SF-12) to the corresponding matched estimates from the Canadian general population (CGP). We also compared PCS values from baseline to 1-year postoperatively by surgical joint adjusting for age, sex and comorbidities using linear regression. We described the volume and the age- and sex-adjusted rates of inpatient surgery for hip, knee and spine OA from 2004 to 2019. **Results:** We analyzed data for 1136 patients from the CSORN registry, and 539 (hip) and 621 (knee) patients from LEAP-OA. Mean baseline and 1-year postoperative PCS values (± standard deviation [SD]) were 28.7 (± 7.5) v. 40.5 (± 10.9) for spine, 31.7 (± 9.2) v. 45.3 (± 10.3) for hip, and 32.9 (± 8.9) v. 41.8 (± 10.2) for knee compared to 50.5 (± 9.0) for the CGP. When controlling for age, sex and comorbidities, PCS improvements were statistically significant and of the same magnitude across surgical groups ($p < 0.0001$). From 2004 to 2019, the number of spine surgeries remained stable (from 1800 to 1900), while there was a 60% increase in hip surgery volumes (7500 to 12 000) and a 47% increase in knee surgery volumes (12 500 to 18 400). The age- and sex-adjusted rates per 100 000 population slightly declined for spine surgeries (from 12.9 to 10.7), and increased for knee (83.6 to 117.4) and hip (51.1 to 67.9) surgeries. **Conclusion:** Hip, knee and spine surgery for OA are associated with a dramatic and similar degree of improvement in HRQoL, and to within 1 SD of age–sex CGP values. Despite similar population prevalence and outcomes, and unlike the case in other jurisdictions, there is gross inequity in access to spine surgery for OA in Ontario.

A-19
Abstract ID 109

What are the predictive factors for compensatory supra-adjacent level lordosis angle changes after lumbar interbody fusion for degenerative spine disease? ***Maroun Rizkallah,[1,2,3] Michel Alexandre Lebreton,[1] Ghassan Boubez,[4] Jesse Shen,[4] Fidaa AlShakfa,[4] Yousef Kamel,[3] Galil Osman,[3] Zhi Wang.[4]*** **From the [1]Dr. Georges-L-Dumont University Hospital Centre, Moncton, N.B.; [2]Sherbrooke University, Sherbrooke, Que.; the [3]Université de Montréal, Montréal, Que.; the [4]Montréal University Health Centre, Montréal, Que.**

Background: Few studies in the literature suggest that angular changes occur in adjacent vertebral levels following lumbar interbody fusion to reduce compensatory lordosis to a more neutral position. None of these studies evaluated the predictive factors associated with this reversal. **Methods:** This retrospective study includes patients with degenerative spine disease who underwent fusion of ≤ 3 levels with 1-level transforaminal lumbar interbody fusion (TLIF). Preoperative and 1-year postoperative sagittal vertical axis (SVA), pelvic incidence (PI), lumbar lordosis (LL),

segmental lordosis (SL) and anterior disk height (ADH) at the TLIF level and at its supra-adjacent level, and whether or not the latter was included in the fusion, were recorded on EOS imaging. The change in SL of the supra-adjacent level (preoperative/1 year/postoperative) was the primary outcome. Multivariate analysis was performed to look for predictive factors for this change. **Results:** A total of 177 patients (55.3% females) were included. SVA averaged 54.79 mm preoperatively and 47.8 mm at 1 year of follow-up. Preoperatively, 45.19% of patients had PI–LL mismatch, whereas 28.81% had PI–LL mismatch at 1 year. SL at the TLIF level increased from 9.72° preoperatively to 14.65° at 1 year. Average SL at the supra-adjacent level went from 15.54° preoperatively to 12.86° at 1 year ($p = 0.03$). ADH at the adjacent level averaged 9.51 mm preoperatively and changed to 8.18 mm at 1 year ($p = 0.08$). Multivariate analysis showed that female sex ($p = 0.03$), a higher amount of postoperative TLIF-level lordosis improvement ($p < 0.01$), a postoperative matching PI–LL ($p = 0.02$) and the non-inclusion of the supra-adjacent level in the fusion ($p < 0.01$) were associated with significantly better supra-adjacent–level neutral lordosis restoration. The level of TLIF and the type of cage were not associated with this restoration. **Conclusion:** Adjacent level biomechanics are dynamic, and the reversal of adjacent lumbar compensatory mechanisms is possible after lumbar fusion. Surgeons should keep in mind the predictive factors for reaching this restoration to neutral, as this would reduce the incidence of adjacent segment disease on medium/long-term follow-up.

A-20
Abstract ID 115

Are nonsteroidal anti-inflammatory drugs appropriate for patients recovering from lumbar fusion surgery for elective spine procedures? A systematic review and meta-analysis. ***Annemarie Dedek, Ryan Greene, Sean D. Christie.*** **From Dalhousie University, Halifax, N.S.**

Background: The postoperative use of nonsteroidal anti-inflammatory drugs (NSAIDs) is believed to reduce reliance on opioids for pain control; however, previous reports and dogma suggest NSAID use impairs fusion. We conducted a systematic review and meta-analysis to weigh the possible benefits of NSAID use with their risk of affecting fusion. **Methods:** We followed PRISMA guidelines. The search strategy was conducted in PubMed, Embase and CINAHL, with search strings related to spine surgery and NSAIDs. Inclusion criteria captured adults who received elective spine fusion surgery for degenerative disease. The intervention was NSAID use postoperatively for pain management, compared to conventional care. All studies were screened by 2 reviewers (A.D. and R.G.). Outcome measures included opioid use (measured as morphine milligram equivalents) and fusion rates. A meta-analysis was performed using a random effects model, and high heterogeneity was determined at $I^2 > 75\%$. Significance was obtained at $p < 0.05$. Risk of bias was assessed using ROBINS-I (Risk Of Bias In Non-randomised Studies – of Interventions). **Results:** We based our search on Geisler et al.'s 2022 pain reports study. Our search returned a total of 253 studies to screen. Eight studies were included in the review. For the outcome of opioid reduction, 4 studies reported favourable outcomes using NSAIDs. Our meta-analysis showed a significant reduction in opioid use ($p = 0.002$, $I^2 = 84\%$). For fusion failure at 1 year, 5 studies were assessed; however, 1 study observed no fusion failure in either group and was thus not estimable. The meta-analysis showed no significant difference in fusion rates among the NSAID and conventional care groups ($p = 0.84$, $I^2 = 27\%$). Risk of bias for the studies was found to be low for 5 studies and moderate for 3. **Conclusion:** We found that NSAIDs are effective postoperative analgesics to reduce opioid use. While some previous reports point to increased rates of failed fusion after NSAID use, our results suggest that patients undergoing spine fusion surgeries are not at increased risk of failed fusion with NSAID use, and, instead, stand to benefit from reduced opioid requirements and more effective pain control.

B-21
Abstract ID 57

The role of bedrest after incidental durotomy in lumbar spine. ***Nikolaus Koegl.*** **From Vancouver General Hospital, Vancouver, B.C.**

Background: Cerebrospinal fluid (CSF) leaks are a well-known complication in spinal surgery, caused mostly by incidental durotomy (ID). Management of ID is a matter of ongoing debate. Various treatment strategies have been described, ranging from no specific treatment to complex reconstructive procedures. The role of bedrest has also been controversially discussed. The aim of this study was to prospectively evaluate a potential change in revision rate following the abandonment of bedrest as a postoperative measure. **Methods:** ID management following lumbar spine surgery at a high-volume centre between December 2018 and January 2020 was prospectively assessed. Several risk factors such as type of surgery, size of dural lesion, intraoperatively chosen strategy, postoperative management (e.g., bedrest) and surgery-related complications were analyzed. Failure of the chosen strategy was defined as symptomatic CSF leakage requiring revision surgery. Results were compared to a retrospective analysis of 135 patients treated between 2014 and 2017. **Results:** A total of 101 patients with intraoperatively detected ID were prospectively evaluated. A significant decrease in postoperatively prescribed bedrest was noted, from 64.4% to 13.9% ($p < 0.001$). Nevertheless, the revision rate decreased to 5.9% (v. 11.9%) despite immediate mobilization ($p = 0.092$). Following logistic regression, the degree of laceration, level of training and type of surgery affected the risk of a negative outcome. **Conclusion:** Postoperative CSF leakage represents a serious postoperative complication of lumbar surgery, causing relevant revision rates. Postoperative bedrest can be spared, as revision rates are as low after immediate postoperative mobilization and seem to rely more on watertight dural closure.

B-22
Abstract ID 44

Decompression versus decompression and fusion and the influence of the lordosis distribution index in the outcome of patients with degenerative lumbar spondylolisthesis. ***Brandon Herrington,[1] Renan R. Fernandes,[1] Jennifer C. Urquhart,[1] Yoga R. Rampersaud,[2] Chris S. Bailey.[1]*** **From the [1]London Health Sciences Centre Combined Neurosurgical and Orthopaedic Spine Program, Schulich School of Medicine, Western University, London, Ont.; the [2]Department of Surgery, University of Toronto, Toronto, Ont.**

Background: The lordosis distribution index (LDI) determines the magnitude of the lower lumbar lordosis (LLL) (L4–S1) relative to the global lumbar lordosis (L1–S1). LDI is important to optimize patient-rated outcomes and prevent adjacent segment disease. In degenerative lumbar spondylolisthesis (DLS), the indication to fuse remains controversial. LDI is currently not considered in this decision. Our objective was to determine whether patient-reported outcome measures (PROMs) are affected by LDI in the comparison of decompression alone (DA) versus decompression and fusion (DF). **Methods:** This retrospective study included patients from 2 sites in the Canadian Spine Outcomes and Research Network (CSORN) prospective DLS study. LDI was calculated as the ratio of L4–S1/L1–S1*100. Patients were stratified by surgery type (DA v. DF) and preoperative LDI (≤ 50% or > 50%). PROMs were compared between surgery type separately for LDI ≤ 50% and > 50% using mixed models of longitudinal regression for repeated measures adjusted for age, sex, preoperative PHQ9 score, and preoperative outcome score. Linear regression was used to determine the association between LLL and LDI at 3 months after surgery. **Results:** In the LDI ≤ 50% cohort, 32 patients had DA and 41 had DF. In the LDI > 50% cohort, 55 patients had DA and 71 had DF. Some baseline demographics differed between the DF and DA groups, including gender, age, disc angle and height, spondylolisthesis grade and PROMs. In the LDI ≤ 50% cohort, the DF group had less back pain (mean difference 1.7, p = 0.002) and disability (Oswestry Disability Index, mean difference 7.5, p = 0.037) at 2 years after surgery in the adjusted analysis. In the LDI > 50% cohort, the DF group had worse back pain in the unadjusted analysis at 24 months (mean difference 1.1, p = 0.039) but not with adjustment (p = 0.088). As the change in LLL increased, so did the LDI in patients who underwent DF but not DA. **Conclusion:** This study was underpowered and further study is necessary, but LDI ≤ 50% could be considered in preoperative planning and the decision to fuse.

B-23
Abstract ID 103

Clinical outcomes after indirect decompression through anterior approaches versus direct decompression with posterior approaches in lumbar interbody fusion — a propensity-matched analysis using data from the Canadian Spine Outcomes and Research Network. ***Ramtin Hakimjavadi,[1] Tinghua Zhang,[2] Zachary DeVries,[3] Eugene K. Wai,[3] Stephen P. Kingwell,[3] Alexandra Stratton,[3] Eve Tsai,[3] Zhi Wang,[4] Philippe Phan,[3] CSORN Investigators.[5]*** **From the [1]University of Ottawa, Ottawa, Ont.; the [2]Ottawa Hospital Research Institute, Ottawa, Ont.; the [3]Ottawa Hospital, Ottawa, Ont.; [4]Centre hospitalier de l'Université de Montréal, Montréal, Que.; the [5]Canadian Spine Society, Markdale, Ont.**

Background: Our objective was to compare long-term (> 1 year) outcomes between anterior (indirect decompression) and posterior (direct decompression) approaches to lumber interbody fusion (LIF) surgery by means of a matched cohort using a nationwide multicentre observational registry. **Methods:** This was a 1-to-1 propensity score matched analysis. Data were collected for adult patients with a degenerative diagnosis who underwent anterior or posterior LIF between Jan. 1, 2015, and Feb. 15, 2022, from the Canadian Spine Outcomes and Research Network national registry, a nationwide multicentre database compiling prospectively collected data from 18 tertiary care academic and nonacademic hospitals across Canada. Baseline variables were used in a logistic regression model for calculating the propensity score for being in the anterior or posterior cohort. Patient-reported outcome measures (PROMs) were compared and included numerical rating scales (NRSs) for leg and back pain, the Oswestry Disability Index (ODI) and the 12-Item Short Form Survey (SF-12) at 12 months and 24 months after surgery and adverse events. **Results:** There were 1339 patients who met inclusion criteria. Sixty-seven patients were in the anterior cohort and 1272 were in the posterior cohort. Before matching, patients in the anterior cohort were significantly younger and had a lower body mass index (BMI). Following matching, 55 patient pairs were identified, and the mean (± standard deviation) ages were 60 (± 10.5) and 62 (± 10.7) years (p = 0.25), the mean BMI 27.8 (± 5.46) and 27.3 (± 4.88) (p = 0.61), and the proportion of females 56.4% and 54.6% (p = 0.84) for anterior and posterior cohorts, respectively. At 1-year follow-up, patients in the anterior cohort had significantly less back pain (2 v. 4, p = 0086); however, this difference did not persist at 2 years. **Conclusion:** Using prospectively collected data from a large nationwide registry in Canada, we found that anterior LIF through indirect decompression was associated with less back pain at 1-year follow-up compared to the standard posterior (direct decompression) approach, but at 2-year follow-up both approaches yielded similar pain relief.

B-24
Abstract ID 141

Candidate epigenetic polygenic risk score to predict pain response following surgical intervention for lumbar spinal stenosis due to spine osteoarthritis. ***Raja Rampersaud,[1] Noah Fine,[1] Laura Stone,[2] Mohit Kapoor.[1]*** **From the [1]Schroeder Arthritis Institute, University Health Network, Toronto, Ont.; the [2]University of Minnesota, Minneapolis, Minn.**

Background: The objective of this study was to identify preoperative serum epigenetic markers predictive of 1-year postoperative pain response following surgery for symptomatic lumbar spinal stenosis due to spine facet osteoarthritis (OA). **Methods:** Using a case–control design, we explored epigenetic signatures in biobanked blood from 40 patients who had had either a super response (70% improvement of baseline pain scores at 12 mo) or nonresponse to surgery (< 30% change). Twenty-three patients were categorized as responders and 17 were nonresponders. DNA methylation libraries and high-throughput sequencing was performed. DNA methylation status was determined at 24 500 gene promoters in all patient samples. β-values, representing the ratio of methylated to total reads (β = methylated/(methylated + unmethylated)) averaged across all CpGs (DNA methylation sites) within a gene promoter, were determined. Lasso logistic penalized regression was carried out using the R package 'glmnet' to identify candidate epigenetic polygenic risk scores (E-PRS) predictive of pain response. **Results:** We identified 210 differentially methylated candidate gene promoters (nominal uncorrected p value < 0.01) in super- relative to nonresponders. Thirty-four of these promoters had greater than a 1.5-fold difference in methylation status in super- versus nonresponders, and, based on a

literature search, 12 of these were associated with inflammatory or neurological processes or diseases. A very high degree of accuracy in differentiating pain response was achieved with candidate E-PRSs dependent on as few as 6 (area under the curve [AUC] 0.957, accuracy 90.0%) or 11 (AUC 0.990, accuracy 92.5%) genes. In comparison, a clinical factors model performed less well (77.5% accuracy). Focussing on the 34 genes that had > 1.5-fold differences in methylation status, we performed a preliminary pathway enrichment analysis based on negatively and positively differentially methylated promoters. We identified 38 and 14 pathways, respectively. Enriched pathways include inflammatory and neuronal signalling. **Conclusion:** We identified biologically plausible candidate E-PRSs that may enable a personalized/precision medicine approach to preoperative prediction of pain response following surgery for LSS due to facet OA. Our ongoing efforts are focused on further validation of the E-PRS predictive ability in a larger cohort.

B-25
Abstract ID 94

Comparative analysis of characteristics and clinical outcomes of discectomy without fusion between upper and lower lumbar disc herniations: a Canadian Spine Outcomes Research Network (CSORN) study. ***Alexandre Chênevert,[1] Sonia Bédard,[2] Greg McIntosh,[3] Julien Goulet,[1,4] Jérome Couture,[1,4] CSORN Investigators,[3] Bernard LaRue.[1,4]*** **From the [1]Orthopedic Division, Surgery Department, Faculté de Médecine et des Sciences de la Santé, Université de Sherbrooke, Sherbrooke, Que.; the [2]Centre de recherche du CHUS, CIUSSS de l'Estrie-CHUS, Sherbrooke, Que.; [3]Canadian Spine Outcomes and Research Network, Markham, Ont.; the [4]Department of Surgery, CIUSSS de l'Estrie-CHUS, Sherbrooke, Que.**

Background: Upper lumbar disc herniations (ULDHs) are infrequent, and there is limited understanding of their postoperative progression in comparison to lower lumbar disc herniations (LLDHs). The aim of this study was to compare baseline characteristics and postoperative course of upper versus lower lumbar disk herniations. **Methods:** This was a retrospective review of prospectively collected data from patients enrolled in the Canadian Spine Outcomes and Research Network (CSORN) national registry between January 2015 and November 2022. All patients underwent single-level discectomy without fusion for ULDH (L1–L2, L2–L3 and L3–L4) or LLDH (L4–L5 and L5–S1). Propensity score matching was utilized to create 2 groups of approximately equal size and demographic factors (ULDH n = 62, LLDH n = 59). Patient-reported outcomes (PROs) of pain (back/leg), disability (Oswestry Disability Index [ODI]) and quality of life (12-Item Short Form Survey [SF-12], EuroQol-5D [EQ-5D]), plus intra- and perioperative adverse events between groups were analyzed at 1-year follow-up. **Results:** Of the 1214 included patients, 92 (7.6%) had ULDH. Compared to the LLDH group, the ULDH group had significantly more males (66.1% v. 48.3%, $p < 0.010$), were significantly older (mean age 60.2 yr v. 44.1 yr, $p < 0.001$) and had higher body mass index (mean 29.5 v. 27.9, $p < 0.032$), and fewer had more than a high school education (53.3% v. 70.6%, $p < 0.008$). Motor/sensory deficit was more common in the ULDH group (61.8% v. 33.3%, $p < 0.043$). There was no statistically significant difference in symptom duration between groups. At 1-year follow-up, all PROs significantly improved within each group compared to their preoperative status ($p < 0.001$), but there were no significant differences in the magnitude of improvement between the ULDH and LLDH groups. There was no difference in blood loss, operative time, hospital length of stay, intraoperative adverse events or perioperative adverse events. **Conclusion:** Based on this CSORN cohort, patients with ULDH differed on 4 baseline demographic characteristics compared to those with LLDH and had more neurological deficits. Our analysis shows that discectomy for ULDH offers important benefits, similar to the improvements in pain, disability and quality of life observed in the operated LLDH group.

B-26
Abstract ID 63

Improvement in multifidus muscle quality following a 12-week exercise program in patients with chronic low back pain: a randomized controlled trial. ***Brent Rosenstein,[1] Meaghan Rye,[1] Alexa Roussac,[1] Neda Naghdi,[1] Luciana G. Macedo,[2] James Elliott,[3,4] Richard DeMont,[1] Michael H. Weber,[5] Véronique Pepin,[1,6] Geoffrey Dover,[1] Maryse Fortin.[1,6]*** **From the [1]Department of Health, Kinesiology and Applied Physiology, Concordia University, Montréal, Que.; the [2]School of Rehabilitation Science, Faculty of Health Sciences, McMaster University, Hamilton, Ont.; the [3]Faculty of Medicine and Health, School of Health Sciences, the Kolling Institute, University of Sydney, Sydney, Australia; the [4]Northern Sydney Local Health District, St Leonards, Australia; the [5]Department of Orthopaedic Surgery, McGill University Health Centre, Montréal, Que.; the [6]PERFORM Centre, School of Health, Concordia University, Montréal, Que.**

Background: Paraspinal muscle fatty infiltration is elevated in people with chronic low back pain (LBP) compared to healthy matched controls and is associated with higher levels of disability, LBP severity and muscle dysfunction. Exercise therapy is well recognized to improve pain and disability in patients with chronic LBP, but its effect on paraspinal muscle composition remains unclear, particularly at the upper lumbar levels. We investigated the effect of a combined motor control and isolated lumbar-strengthening exercise (MC+ILEX) versus general exercise (GE) on upper lumbar paraspinal muscle fatty infiltration in individuals with chronic LBP. **Methods:** Participants with chronic LBP were randomly allocated to each group (MC+ILEX, n = 25; GE, n = 25) and completed a 12-week supervised intervention program (2 sessions per week). IDEAL (LAVA-flex, 2-echo) fat and water magnetic resonance imaging (MRI) was acquired at baseline, 6 weeks and 12 weeks to examine the impact of each intervention on multifidus and erector spinae muscle fatty infiltration (% fat signal fraction) at L1–L2, L2–L3 and L3–L4. **Results:** A mixed-model analysis of variance with repeated measures revealed no significant time*group interaction for multifidus or erector spinae fatty infiltration at L1–L2, L2–L3 or L3–L4 (all $p > 0.05$). Both groups showed a significant decrease in multifidus fatty infiltration at L1–L2 (MC+ILEX: –4.38, 95% confidence interval [CI] –6.07 to –2.70; GE: –3.23, 95% CI –5.00 to –1.47), at L2–L3 (MC+ILEX: –3.78, 95% CI –5.52 to –2.04; GE: –2.55, 95% CI –4.30 to –0.81) and at L3–L4

(MC+ILEX: –3.71, 95% CI –5.27 to –2.14; GE: –3.07, 95% CI–4.74 to –1.39) after the intervention. A significant erector spinae fatty infiltration decrease was also observed at L1–L2 in both groups (MC+ILEX: –3.98, 95% CI –6.58 to –1.38; GE: –5.10, 95% CI –7.82 to –2.38), with no significant changes in erector spinae fatty infiltration at L2–L3 or L3–L4. **Conclusion:** This study provided preliminary evidence suggesting that both MC+ILEX and GE interventions included in this trial may help improve multifidus muscle quality at the upper lumbar levels in participants with chronic LBP. The effect of fatty infiltration on muscle functional capacity is understudied and warrants further investigation.

B-27
Abstract ID 121

Predictive factors for distal adjacent segment disease in short lumbar fusions ending at L5. ***Zhi Wang,[1] Maroun Rizkallah,[2,3,4] Jesse Shen,[1] Michel Alexandre Lebreton,[2] Edisond Florial,[1] Fidaa AlShakfa,[4] Ghassan Boubez.[1]*** **From the [1]Montréal University Health Centre, Montréal, Que.; the [2]Dr. Georges-L.-Dumont University Hospital Centre, Moncton, N.B.; [3]Sherbrooke University, Sherbrooke, Que.; the [4]Université de Montréal, Montréal, Que.**

Background: Multiple previous studies assessed the risk factors for distal junctional failures in long thoracolumbar fusions stopping at L5, but none evaluated the long-term risk factors for distal adjacent segment disease (DASD) in patients with short lumbar fusion ending at L5. **Methods:** This retrospective study included patients with degenerative spine disease who underwent ≤ 3-level fusion stopping at L5, with a minimum of 2 years of follow-up. Patients' charts were reviewed, and preoperative as well as postoperative sagittal vertical axis (SVA), pelvic incidence (PI) and lumbar lordosis (LL) were recorded on EOS imaging. The need for distal extension of fusion for DASD was the primary outcome. Multivariate analysis was performed to look for predictive factors for this revision surgery. **Results:** A total of 228 patients (52.25% females) were included, with a mean follow-up duration of 74 months. Of those, 132 (58%) had 1-level fusion, 68 (30%) had 2-level fusion, and 28 (12%) had 3-level fusion. One cage for interbody fusion was used in 52% of patients, whereas no interbody fusion was performed in the remaining 48%. Perioperative unilateral/bilateral L5 foraminotomy for preoperative L5 foraminal stenosis diagnosed on magnetic resonance imaging was performed in 15% of patients. Revision surgery for DASD occurred in 42 patients (18%) during their follow-up. About 12% of patients with a cage needed revision surgery, compared to 24.7% of patients without interbody fusion ($p = 0.04$). About 36% of patients who had L5 foraminotomy had revision surgery compared to 15.7% of those who did not ($p = 0.035$). Multivariate analysis showed that female patients ($p < 0.01$), absence of interbody fusion ($p < 0.01$) and peroperative L5 foraminotomy ($p = 0.02$) were associated with a significantly increased risk for DASD-related revision surgery, whereas body mass index, postoperative SVA and PI–LL mismatch were not. **Conclusion:** In the long term, DASD occurred in a significant proportion of patients with short lumbar fusion ending at L5. In female patients, those with preoperative L5 foraminal stenosis and those in whom no interbody fusion is planned, surgeons should consider extending fusion down to S1 in short lumbar fusions.

B-28
Abstract ID 75

Impact of 1- or 2-level minimally invasive surgery versus open lumbar interbody fusion on postoperative opioid use. ***Aditya Raj,[1] Prarthan Amin,[1] Greg McIntosh,[2] Yoga Raja Rampersaud.[1]*** **From the [1]Toronto Western Hospital, Toronto, Ont.; and [2]Canadian Spine Outcomes and Research Network, Markdale, Ont.**

Background: One of the reported benefits of minimally invasive surgery (MIS) fusion is reduced pain and need for use of postoperative opioids. The aim of this study was to investigate potential differences in patterns of pre- to- postsurgery opioid utilization changes among patients undergoing open versus MIS lumbar fusion. **Methods:** This was a retrospective review of Canadian Spine Outcomes and Research Network (CSORN) registry data. Surgical patients ($n = 511$) with degenerative lumbar disorders undergoing posterior decompression and interbody instrumented fusion (1 or 2 levels) and available data on baseline opioid use were categorized into open ($n = 307$) and MIS ($n = 204$) groups. Changes in opioid use from preoperative status to 3 and 12 months after surgery were compared between the 2 groups. **Results:** There was no significant difference in baseline opioid use between groups (48.5% and 45.6%, respectively). Baseline patient-reported outcomes (PROs), demographic and presurgical characteristics were comparable between groups except that the MIS group had slightly lower reported leg pain rating (6.94 v. 7.56, $p < 0.001$) and number of comorbidities (2.7 v. 3.0, $p < 0.0028$). Postoperatively, the MIS group had significantly less operative time (164 min v. 208 min), mean blood loss (159 v. 450 mL) and length of stay (3.1 d v. 4.6 d), $p < 0.001$. There were no significant differences in change in PROs between the 2 groups at either follow-up. There were no significant differences in the patterns of opioid utilization changes from baseline to 12 months postoperatively between the groups ($p > 0.05$) (nonusers who stayed nonusers: open = 47.9%, MIS = 50.5%; users who stayed users: open = 18.9%, MIS = 19.1%; nonusers who became users: open = 3.6%, MIS = 3.9%; users who became nonusers: open = 29.6%, MIS = 26.5%). **Conclusion:** Compared to open 1- or 2-level interbody fusion, use of an MIS technique did not differentially impact 3- and 12-month opioid utilization. Approximately 1 in 5 patients were still using opioids at 12 months postoperatively irrespective of MIS or open fusion technique.

B-29
Abstract ID 127

Revision lumbar fusions exhibit worse clinical outcomes when compared with primary fusions: a matched cohort analysis using the Canadian Spine Outcomes and Research Network Registry. ***Abdullah A.S.M. AlDuwaisan,[1,2] Ramtin Hakimjavadi,[1] Tinghua Zhang,[3] Kim Phan,[1] Alexandra Stratton,[4] Eve Tsai,[1] Stephen Kingwell,[1] Eugene Wai,[1] Philippe Phan,[1] CSORN Investigators.[1]*** **From the [1]University of Ottawa, Ottawa, Ont.; the [2]University of Calgary, Calgary, Alta.; the [3]Ottawa Hospital Research Institute, Ottawa, Ont.; the [4]University of Ottawa, Ottawa, Ont.**

Background: Revision lumbar fusion may be indicated for a variety of different pathologies including adjacent segment disease,

recurrent stenosis or pseudarthrosis. Limited evidence is available regarding patient-reported outcome measures (PROMs) following revision lumbar fusions; however, studies available would suggest worse clinical outcomes following revision lumbar fusions. This may confounded by a variety of confounders including smoking and preoperative comorbidities. The aim of this study was to assess PROMs in patients undergoing revision lumbar fusions when compared to primary lumbar fusions. **Methods:** Patient data were collected from the Canadian Spine Outcomes Research Network (CSORN) database. Patients undergoing lumbar fusions were included. Patients under 18 years, or undergoing surgery for infection, trauma, malignancy, deformity, concomitant cervical or thoracic spine surgery were excluded. Patients undergoing primary versus revision lumbar fusions were matched in a 1:1 ratio using propensity scores. Age, sex, diabetes, smoking status, American Society of Anesthesiologists (ASA) status and body mass index were included in the propensity score model. Mean and standard deviations for the Oswestry Disability Index (ODI), EuroQol-5D (EQ-5D), 12-Item Short Form Survey (SF-12) Physical Component Summary (PCS) and Mental Component Summary (MCS), and visual analogue scale leg and back pain scores preoperatively and at 6–18 weeks and 12 months postoperatively were compared using paired *t* tests after matching. **Results:** A total of 1392 patients were included, with 696 patients in the primary and revision groups each. Patients in both cohorts demonstrated improvement in all PROMs. Patients undergoing revision lumbar fusion, however, experienced significantly less improvement in all PROMs when compared to their primary fusion counterparts. Despite this, clinical improvement following revision lumbar fusion met the minimum clinically important difference thresholds for all PROMs. **Conclusion:** In a matched cohort model, patients undergoing revision lumbar fusion demonstrated less clinical improvement following surgery when compared to patients undergoing a primary lumbar fusion. However, they still obtained clinically meaningful gains following revision fusion. This study represents the largest to date assessing PROMs in patients undergoing revision lumbar fusion. Our results may be of use to spine surgeons counselling patients on expected outcomes following revision lumbar fusion.

B-30
Abstract ID 74

Outcome prediction following lumbar disc surgery (OptiDisc): a longitudinal study of outcome trajectories, prognostic factors and risk models. ***Jeffrey Hebert,[1] Sarah Nowell,[1] Niels Wedderkopp,[2] Amanda Vandewint,[3,4] Neil Manson,[3,4,5] Edward Abraham,[3,4,5] Christopher Small,[3,4,5] Najmedden Attabib,[4,5] Erin Bigney.[1,4,5]*** **From the [1]University of New Brunswick, Fredericton, N.B.; the [2]University of Southern Denmark, Odense, Denmark; [3]Dalhousie University, Saint John, N.B.; the [4]Canada East Spine Centre, Saint John, N.B.; the [5]Horizon Health Network, Saint John, N.B.**

Background: Although lumbar discectomy for radiculopathy effectively reduces pain and disability for most patients, some report continued pain following surgery. Information to predict patient outcomes following discectomy could assist surgeons with patient selection. This study aimed to 1) describe the perioperative trajectories of leg pain and overall clinical outcome following lumbar disc surgery for radiculopathy, 2) identify the preoperative prognostic factors that predict trajectories representing poor clinical outcomes, and 3) develop and internally validate multivariable prognostic models. **Methods:** This cohort study included patients enrolled in the Canadian Spine Outcomes and Research Network (CSORN) diagnosed with lumbar disc pathology and radiculopathy who underwent lumbar discectomy at 1 of 18 spine centres. Potential outcome predictors included preoperative demographic, health-related and clinical prognostic factors. Clinical outcomes were univariable latent-class trajectories of leg pain intensity (Numeric Pain Rating Scale) and overall outcomes modelled with multivariable trajectories of leg and back pain intensity and pain-related disability (Oswestry Disability Index). Multivariable risk model performance and internal validity were evaluated with discrimination and calibration statistics based on bootstrap shrinkage with 500 resamplings. **Results:** We included data from 1142 patients (47.6% female) who underwent surgery performed by 1 of 66 surgeons. The trajectory models identified 3 subgroups, with 11.4% of patients in the leg pain model and 28.2% in the overall outcome model experiencing a poor clinical outcome. Eleven demographic, health and clinical factors predicted patients' leg pain and overall outcomes. The performance of the leg pain risk model was inadequate. The overall outcome model had acceptable discrimination, calibration and evidence of internal validity in predicting patients at risk of experiencing a poor outcome following discectomy. **Conclusion:** Patients experienced heterogeneous outcomes following lumbar discectomy that were associated with numerous preoperative prognostic factors. A multivariable risk model adequately predicted the overall outcomes experienced by patients. This tool can assist with patient selection for lumbar discectomy but requires additional replication and validation before confident clinical implementation.

C-31
Abstract ID 56

Mild degenerative cervical myelopathy — patients at risk of conservative treatment failure. ***Nikolaus Koegl.*** **From Vancouver General Hospital, Vancouver, B.C.**

Background: Degenerative cervical myelopathy (DCM) is the most common cause of spinal cord dysfunction in adults. Surgery is recommended in patients with moderate or severe DCM. However, the treatment of choice is uncertain in patients with mild DCM. While some authors report meaningful improvement with surgery in the mild category, the current literature is limited by the absence of a control nonoperative group. The main goal of this study was to describe the natural history of patients with mild myelopathy and to analyze risk factors for failure of nonsurgical management. **Methods:** Data from the Canadian Spine Outcomes and Research Network (CSORN) DCM prospective cohort study were analyzed. This cohort includes both operative and nonoperative patients. For this analysis, only patients with mild DCM (mJOA [modified Japanese Orthopaedic Association] score 15–18) with clinical and radiographic follow-up at 1 year were included. The primary outcome was mJOA at 12 months after enrolment. Secondary outcomes included various patient-reported outcomes (Neck Disability Index, Numeric Pain Rating Scale, EuroQol-5D [EQ-5D]). A logistic regression was performed to assess potential risk factors for conservative treatment

failure and crossover to the surgical group. **Results:** A total of 389 patients with mild myelopathy were identified. Of those, 245 (63%) were initially treated surgically and 144 (37%) conservatively. At up to 5 years' follow-up, 30 patients (17%) initially treated conservatively crossed over to surgical treatment. Most patients who were treated conservatively did not deteriorate neurologically. Logistic regression revealed which clinical and radiological factors were associated with a higher risk of deterioration. **Conclusion:** Conservative management is appropriate for most patients with mild DCM. However, a thorough neurologic and radiologic assessment is key to select those patients at risk in order to offer a timely surgical intervention.

C-32
Abstract ID 61

Automated magnetic resonance imaging risk stratification of clinical deterioration in mild cervical myelopathy. ***Michael Craig,[1,2] Abdul Al-Shawwa,[3,4] Kalum Ost,[3,5] Saswati Tripathy,[3] Nathan Evaniew,[1,6] Bradley Jacobs,[1,2] David Cadotte.[1,2,3]*** **From the [1]Combined Orthopaedic and Neurosurgical Spine Program, University of Calgary, Calgary, Alta.; the [2]Section of Neurosurgery, Department of Clinical Neurosciences, University of Calgary, Calgary, Alta.; the [3]Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, Alta.; the [4]Department of Medical Sciences, Cumming School of Medicine, University of Calgary, Calgary, Alta.; the [5]Department of Biochemistry and Molecular Biology, Cumming School of Medicine, University of Calgary, Calgary, Alta.; the [6]Section of Orthopaedic Surgery, Department of Surgery, University of Calgary, Calgary, Alta.**

Background: Optimal treatment for mild degenerative cervical myelopathy (DCM) retains a great deal of equipoise. Ability to predict clinical deterioration would guide treatment significantly. While it is thought that greater radiological spinal cord compression is associated with neurological deterioration, our clinical experience suggests a more complex mechanism involving spinal canal diameter (SCD). We aimed to use unsupervised machine learning (ML) methods to understand the relationship between SCD and different radiologic profiles of cord compression and identify radiologic phenotypes at risk of neurological deterioration. **Methods:** A total of 124 magnetic resonance imaging (MRI) scans from nonoperative patients with mild DCM and baseline and 6 month modified Japanese Orthopaedic Association (mJOA) scores were identified. Manual scoring of cord compression and SCD measurements was done. Then, through ML methods, pairwise controlled manifold approximation (PaCMAP) dimensionality reduction in conjunction with k-means clustering was used to establish patient groups. We then assessed the change between mJOA score at baseline and at 6 months, specifically, whether the minimal clinically important difference (MCID) for clinical deterioration was reached. Univariate analyses were performed at statistical significance of $p < 0.05$. **Results:** The mean baseline mJOA score in our cohort was 16.4 (standard deviation 1.5). Across the 124 studies, 45 were associated with reaching MCID for clinical deterioration at 6 months, and 79 were not. Through our ML approach, 5 MRI phenotypes were identified and grouped. Each group was described in terms of mean SCD and a "defining" cord compression profile (number and location of spinal levels with varying degrees of stenosis). Each group had a different risk of reaching MCID for deterioration of mJOA at 6 months. When the SCD was greater than 15.75 mm, the risk of clinical deterioration was low, and with SCD less than 14.5 mm, the risk was high. With SCDs falling between these extremes, specific cord compression profile becomes important in stratifying risk of clinical deterioration. **Conclusion:** SCD and presence of focal cord compression alone did not predict an increased risk of neurological deterioration in mild DCM. A specific combination of SCD and focal cord compression profile increased the likelihood of neurological deterioration.

C-33
Abstract ID 7

The effects of perioperative adverse events on clinical and patient-reported outcomes after surgery for degenerative cervical myelopathy: an observational cohort study from the Canadian Spine Outcomes and Research Network. ***Armaan K. Malhotra,[1] Nathan Evaniew,[2] Nicolas Dea,[3] CSORN Investigators,[4] Greg McIntosh,[4] Jefferson R. Wilson.[5]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]University of Calgary, Calgary, Alta.; [3]Vancouver General Hospital, Vancouver, B.C.; the [4]Canadian Spine Outcomes Research Network, Markdale, Ont.; [5]Unity Health, University of Toronto, Toronto, Ont.**

Background: There is a lack of data examining the effects of perioperative adverse events (AEs) on long-term outcomes for patients undergoing surgery for degenerative cervical myelopathy (DCM). We aimed to investigate associations between the occurrence of perioperative AEs and coprimary outcomes: 1) modified Japanese Orthopaedic Association (mJOA) score and 2) Neck Disability Index (NDI) score. **Methods:** We analyzed data from 800 consecutive patients prospectively enrolled in the Canadian Spine Outcomes and Research Network multicentre observational study. The Spinal Adverse Events Severity System was used to collect intra- and postoperative AEs. Patients were assessed at up to 2 years postoperatively using the NDI and the mJOA scale. We used a linear mixed effect regression to assess the influence of AEs on longitudinal outcome measures, and multivariable logistic regression to assess factors associated with meeting minimal clinically important difference (MCID) thresholds at 1 year. **Results:** There were 167 patients (20.9%) with minor AEs and 36 patients (4.5%) with major AEs. The occurrence of major AEs was associated with an average increase in NDI of 6.8 points (95% confidence interval [CI] 1.1–12.4, $p = 0.019$) and reduction of 1.5 points for mJOA scores (95% CI –2.3 to –0.8, $p < 0.001$) up to 2 years after surgery. Occurrence of major AEs reduced the odds of patients achieving MCID targets at 1-year postoperatively for mJOA (odds ratio [OR] 0.23, 95% CI 0.086–0.53, $p = 0.001$) and for NDI (OR 0.34, 95% CI 0.11–0.84, $p = 0.032$). **Conclusion:** Major AEs were associated with reduced functional gains and worse recovery trajectories for patients undergoing surgery for DCM. Occurrence of major AEs reduced the probability of achieving mJOA and NDI MCID thresholds at 1 year. Both minor and major AEs significantly increased health resource utilization by reducing the proportion of discharges home and increasing length of stay.

C-34
Abstract ID 11

Anterior versus posterior surgery for patients with degenerative cervical myelopathy: an observational study from the Canadian Spine Outcomes and Research Network. ***Nathan Evaniew,[1] Christopher S. Bailey,[2] Y. Raja Rampersaud,[3] W. Bradley Jacobs,[1] Philippe Phan Phan,[4] Andrew Nataraj,[5] David W. Cadotte,[1] Michael H. Weber,[6] Kenneth C. Thomas,[7] Neil Manson,[8] Najmedden Attabib,[8] Jerome Paquet,[9] Sean D. Christie,[10] Jefferson R. Wilson,[3] Hamilton Hall,[3] Charles G. Fisher,[11] Greg McIntosh,[12] Nicolas Dea.[11]*** **From the [1]University of Calgary, Calgary, Alta.; [2]Western University, London, Ont.; the [3]University of Toronto, Toronto, Ont.; the [4]University of Ottawa, Ottawa, Ont.; the [5]University of Alberta, Edmonton, Alta.; [6]McGill University, Montréal, Que.; the [7]University of Calgary, Calgary, Alta.; the [8]Canada East Spine Centre, Saint John, N.B.; the [9]Université du Québec, Québec, Que.; [10]Dalhousie University, Halifax, N.S.; the [11]University of British Columbia, Vancouver, B.C.; [12]Canadian Spine Outcomes and Research Network, Toronto, Ont.**

Background: The advantages and disadvantages of anterior versus posterior surgical approaches for patients with progressive degenerative cervical myelopathy (DCM) remain uncertain. Our primary objective was to compare patient-reported disability at 1 year after surgery. Our secondary objectives were to evaluate differences in patient profiles selected for each approach in routine clinical practice, and to compare neurological function, neck and arm pain, health-related quality of life, adverse events and rates of reoperation. **Methods:** We analyzed data from patients with DCM who were enrolled in an ongoing multicentre prospective observational cohort study. We controlled for differences in baseline characteristics and number of spinal levels treated using multiple logistic regression. Adverse events (AEs) were collected according to the Spinal Adverse Events Severity System. **Results:** Among 559 patients, 261 (47%) underwent anterior surgery, while 298 (53%) underwent posterior surgery. Patients treated posteriorly had significantly worse DCM severity and a greater number of vertebral levels involved. After adjustment for confounders, there was no significant difference between approaches for odds of achieving the minimum clinically important difference (MCID) for the Neck Disability Index (odds ratio 1.23, 95% confidence interval 0.82–1.86, $p = 0.31$). There was also no significant difference for change in modified Japanese Orthopaedic Association (mJOA) scores, and differences in neck and arm pain and health-related quality of life did not exceed MCIDs. Patients treated anteriorly experienced greater rates of dysphagia, while patients treated posteriorly experienced greater rates of wound complications, neurological complications and reoperation. **Conclusion:** Patients selected for posterior surgery had worse DCM and a greater number of vertebral levels involved. Despite this, anterior and posterior surgery were associated with similar improvements in disability, neurological function, pain and quality of life. Anterior surgery had a more favorable profile of adverse events, which suggests it might be a preferred option when feasible.

C-35
Abstract ID 20

Long-term (> 24 months) duration of symptoms negatively impacts patient-reported outcomes following anterior cervical discectomy and fusion for cervical radiculopathy. ***Eva Y. Liu,[1] Amit R.L. Persad,[1,2] Nathan Baron,[1] Daryl Fourney.[1]*** **From the [1]University of Saskatchewan, Saskatoon, Sask.; [2]Stanford University, Palo Alto, Calif.**

Background: Anterior cervical discectomy and fusion (ACDF) is an effective treatment to relieve symptoms of cervical radiculopathy. However, there is no consensus on whether prolonged preoperative length of symptoms negatively impacts postoperative outcomes. This retrospective cohort study investigated the impact of long symptom duration (> 24 mo) on patient self-reported outcomes for pain, function and quality of life following ACDF for cervical radiculopathy. **Methods:** This study included consecutive patients who underwent ACDF for cervical radiculopathy from May 1, 2012, to Dec. 1, 2019 performed by a single surgeon. Patients were stratified by short (≤ 24 mo) or long (> 24 mo) duration of symptoms. Outcomes including Visual Analogue Scale (VAS) neck and arm, Neck Disability Index (NDI), EuroQol-5D (EQ-5D) and overall state of health (EQ-VAS) were compared between cohorts both for absolute values and percentage of patients achieving minimal clinically important difference (MCID). **Results:** A total of 111 consecutive patients were included in our study, 59 patients in the short symptom duration group and 52 patients in the long symptom duration group. The mean age of the patients was 51.4 (standard deviation 9.4) years, and 41 (36.9%) were female. The baseline VAS neck and arm, NDI, EQ-5D and EQ-VAS values were similar between groups. Patients in both the long and short symptom duration groups had clinical improvement following surgery. However, patients with short symptom duration had better VAS neck and EQ-5D outcomes, and were more likely to meet MCID for NDI, EQ-5D or any outcome. Multivariate analysis confirmed symptom duration < 24 months as an independent predictor for better patient-reported outcomes. **Conclusion:** We found better clinical outcomes in patients who underwent ACDF for cervical radiculopathy with shorter symptom duration. Based on these data, we would advocate for prompt treatment of cervical radiculopathy to avoid long-term impairment.

C-36
Abstract ID 24

Predictors associated with achieving the minimal clinically important difference in patient-reported outcomes after surgery for degenerative cervical myelopathy: a national multicentre cohort analysis from the Canadian Spine Outcomes and Research Network. ***Husain Shakil,[1] CSORN Investigators,[2] Nathan Evaniew,[3] Jefferson R. Wilson,[1] Nicolas Dea.[4]*** **From the [1]University of Toronto, Toronto, Ont.; [2]Canadian Spine Outcomes and Research Network, Markdale, Ont.; the [3]University of Calgary, Calgary, Alta.; the [4]University of British Columbia, Vancouver, B.C.**

Background: Outcomes after surgery for degenerative cervical myelopathy (DCM) vary. To inform patient decision-making, this study evaluated preoperative predictors associated with achieving

the minimal clinically important difference (MCID) in patient-reported outcomes (PROs) such as Neck Disability Index (NDI) and EuroQol-5D (EQ-5D) at 12 months postoperatively. **Methods:** An observation cohort study was conducted utilizing data from the Canadian Spine Outcomes and Research Network (CSORN) registry collected between 2015 and 2022. All patients with DCM who underwent surgery, had completed 12 months of follow-up and had PROs measured at follow-up were included. Clinical predictors were selected based on availability and clinical relevance. We employed both multivariable LASSO regression and machine learning (ML) to identify significant predictors of achieving the MCID in outcomes. Variable importance was measured using standardized coefficients and SHAP values. **Results:** Of the 362 patients included, 41.4% achieved the MCID for NDI, and 60.5% for EQ-5D. LASSO regression for predicting the likelihood of achieving the MCID in NDI showed the variable importance ranking to be presence of spinal cord compression, baseline NDI score, then symptom duration. For EQ-5D, the variable importance ranking was found to baseline EQ-5D score, living arrangement, presence of T_1 or T_2 signal change on magnetic resonance imaging (MRI), then symptom duration. ML analysis corroborated findings of baseline NDI score and symptom duration to be important factors for predicting the likelihood of achieving the MCID in NDI. Similarly, ML analysis corroborated findings of baseline EQ-5D score, symptom duration, living arrangement and presence of signal change on MRI to be important factors in predicting patient likelihood of achieving the MCID in EQ-5D. **Conclusion:** Surgery for DCM was associated with a significant improvement in patient-reported NDI and EQ-5D scores. Baseline patient NDI and EQ-5D scores, symptom duration, signal change on MRI and living arrangement appeared to impact the likelihood of achieving the MCID in outcomes. Timing of surgery with respect to patient symptoms is underscored as a crucial and modifiable patient factor that is associated with an increased likelihood of achieving clinically meaningful outcomes for patients with DCM.

C-37
Abstract ID 155

A data-driven classification of degenerative cervical myelopathy leads to clinically relevant subgroups with distinct preoperative features and postsurgical outcomes: a CSORN study. ***Philippe Phan,[1] Jingyi Huang,[2] Nader Fallah,[2,3] Charlotte Dandurand,[4] the CSORN Investigators.[5]***
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Background: Outcome prognostication of patients with degenerative cervical myelopathy (DCM) is difficult owing to the significant heterogeneity that exists within this population. We aimed to identify subgroups of patients with DCM with clinical similarities and distinct outcome patterns using a data-driven approach. **Methods:** K-prototype clustering was applied to a national prospective DCM database to identify patient subgroups based on relevant features influencing outcomes documented in the literature (age, time with condition, mJOA [modified Japanese Orthopaedic Association] score, 12-Item Short Form Survey [SF-12] score, EuroQol-5D [EQ-5D] score, magnetic resonance imaging cord findings, motor and sensory deficits, number of levels involved, number of comorbidities and current work status). Outcome measures using mJOA, SF-12 (Physical Component Summary and Mental Component Summary), EQ-5D, Neck Disability Index (NDI), work status, residual pain and satisfaction with surgery were computed for each cluster and compared using the Kruskal–Wallis and Mann–Whitney tests. **Results:** Data for 774 patients were analyzed. A classification with 4 clusters was developed, with each cluster having statistically significant different means for all demographics, mJOA and patient-reported outcome measures (PROMs) baseline scores as well as 1-year postoperative total and change in mJOA, SF-12, EQ-5D and NDI scores. The 4 clusters with distinct features and prognosis were defined as follows: cluster 1: mild disease with radiographic findings with least mJOA score and PROM improvement postoperatively; cluster 2: youngest patients with moderate disease and high functional recovery; cluster 3: oldest patients with most comorbidities with moderate disease and good baseline mental state but gaining the least functionally from surgery; and cluster 4: patients with most severe disease and longest duration with most significant improvement of functional and mental health scores. Despite the distinct features between the groups, patients in all clusters were similarly satisfied with the surgery and would repeat it. **Conclusion:** Using an unsupervised ML algorithm, we identified 4 clinically relevant subgroups of patients with DCM. Each cluster had distinguishable features that influenced outcome measures in distinct directions. Clustering of DCM patients with DCM could help physicians segment that population and help provide more nuanced counselling on outcomes using this new type of data-driven stratification of the DCM population.

C-38
Abstract ID 148

Clinical outcomes of surgical treatment of degenerative cervical myelopathy: a long-term follow up study. ***Thamer Alfawaz,[1] Tinghua Zhang,[1] Alexandra Stratton,[1] Eve Tsai,[1] Eugene Wai,[1] Stephen Kingwell,[1] Zhi Wang,[2] Philippe Phan,[1] CSORN Investigators.[3]*** **From the [1]University of Ottawa, Ottawa, Ont.; [2]Centre hospitalier de l'Université de Montréal, Montréal, Que.; the [3]Canadian Spine Society, Markdale, Ont.**

Background: Degenerative cervical myelopathy (DCM) is considered the most common cause of spinal cord dysfunction, and it is expected to become more prevalent as populations age. As a progressive disease, patients affected have limited independence and poorer quality of life. Early diagnosis and treatment are paramount in achieving a good outcome, as early treatment can halt progression and improve functional recovery. In our study we analyzed patient-reported outcome measures (PROMs) for patients treated surgically for DCM in a 5-year follow-up study. **Methods:** Data were collected from the Canadian Spine Outcomes and Research Network (CSORN) database. Patients undergoing surgery for DCM were included, and patients under 18 years of age, and those with trauma, tumour or infection were excluded. PROMs used were numeric arm and neck pain, EuroQol-5D (EQ-5D) score, Neck Disability Index (NDI) score, modified Japanese Orthopaedic Association (mJOA) score and 12-Item Short Form Survey (SF-12) score. Mean and

standard deviation, or median and interquartile range were reported. A paired *t* test was used to compare means of outcome between year 1 and year 5. The Wilcoxon signed-rank test was applied to compare median of outcome between year 1 and year 5. For all statistical tests, a 2-tailed test was used to determine significance at 5% level. **Results:** A total of 186 patients completed the 5 years of follow-up, 171 of whom met the inclusion criteria. At both follow-up periods, there was no statistically significant difference in PROMs for neck pain, NDI score, mJOA score or SF-12 score (p = 0.0879, 0.5263 and 0.8295, respectively; and p = 0.5823 for Physical Component Summary and 0.4267 for Mental Component Summary). The same was found for EQ-5D score with the exception of improvement in health state. There was an improvement in numeric arm pain score (p = 0.0018). **Conclusion:** In our 5-year follow-up study, patients undergoing surgery for DCM showed sustained clinical results at 1-year and 5-year follow-up. No significant deterioration in PROMs was noted. Results also show that patients can experience improvement in arm pain and health state scores over time.

C-39
Abstract ID 137

Fulfillment of patient expectations after surgery for degenerative cervical myelopathy. A retrospective analysis of prospectively collected data from the multicentre Canadian Surgical Spine Registry (CSORN). ***Julien Francisco Zaldivar-Jolissaint,[1] Raphaële Charest-Morin,[1] Greg McIntosh.[2]*** **From the [1]University of British Columbia, Vancouver, B.C.; and [2]Canadian Spine Outcomes and Research Network, Markdale, Ont.**

Background: Abundant literature exists on the benefits of surgery for degenerative cervical myelopathy (DCM), but it is unknown how patients' preoperative expectations are met following surgery. The primary objective was to report on fulfillment of preoperative expectations at 12 months after surgery. Secondary objective was to identify factors associated with patient expectation fulfillment. **Methods:** In this retrospective study of a prospective multicentre cohort, patients who underwent surgical treatment for DCM between April 2015 and September 2021 who had completed the baseline expectation questionnaire and had 12 months follow-up available were included. Patients completed preoperatively an 11-domain questionnaire, quantifying their expected changes in each domain. At 12 months, patients reported how surgery had met their preoperative expectations in the same 11 domains. Multivariable logistic regression models were employed to identify factors associated with expectation fulfillment. **Results:** A total of 490 patients met the inclusion criteria. Of these, 49.2% had all their expectations met, 11.2% had at least their most important expectation met, 35.9% had their most important expectation not met, and 3.7% had none of their expectations met. Predictors of expectation fulfillment were not using pain medication before surgery (odds ratio [OR] 1.88, 95% confidence interval [CI] 1.13–3.14, p = 0.02), lower Patient Health Questionnaire-8 score (OR 0.91, 95% CI 0.88–0.95, p < 0.01), improvement in Numeric Pain Rating Scale neck pain score (OR 0.92 for 1-point improvement, 95% CI 0.85–1.00, p = 0.049), greater improvement in 12-Item Short Form Survey (SF-12) Physical Component Summary and Mental Component Summary scores (OR for 1-point improvement 1.06, 95% CI 1.03–1.08, p < 0.01, and 1.08, 95% CI 1.05–1.1, p < 0.01, respectively), no perioperative adverse events (OR 2.02 , 95% CI 1.13–3.60, p = 0.02) and fewer operative levels operated on (OR 0.86 per level, 95% CI 0.76–0.99, p = 0.03). **Conclusion:** Sixty percent of the patients who underwent surgery for DCM had at least their most important expectations met. Expectation fulfillment at 12 months was associated with preoperative factors, surgical factors and improvement in their patient-reported outcomes.

C-40
Abstract ID 28

Re-analysis of the CSM-Protect multicentre randomized controlled trial reveals a global treatment benefit of riluzole in patients undergoing surgery for degenerative cervical myelopathy. ***Michael G. Fehlings,[1] Karlo M. Pedro,[1] Mohammed Ali Alvi.[2]*** **From the [1]Toronto Western Hospital, University of Toronto, Toronto, Ont.; the [2]Toronto Western Hospital, Toronto, Ont.**

Background: While the primary analysis of the Efficacy of Riluzole in Surgical Treatment for Cervical Spondylotic Myelopathy (CSM-Protect) trial did not demonstrate improved recovery with the adjunctive use of riluzole in patients with degenerative cervical myelopathy (DCM) undergoing surgical intervention, secondary analyses suggested potential therapeutic benefits not captured by the modified Japanese Orthopedic Association (mJOA) scale. This study aimed to re-evaluate riluzole's efficacy using a global statistical analysis encompassing multiple outcomes. **Methods:** In this reanalysis, we examined data from the phase III CSM-Protect study involving 290 patients with DCM who underwent decompressive surgery. We assessed clinical improvement at 1 year using 5 distinct assessment scales: 36-Item Short-Form Health Survey (SF-36) Physical Component Summary, Numeric Rating Scale (NRS) for neck and arm pain, American Spinal Cord Injury Association (ASIA) motor score and Nurick grade. A nonparametric global statistical approach was used to evaluate treatment efficacy. The resulting global treatment effect (GTE), ranging from –1 to 1, measured the net gain in probability that 1 arm outperforms the other across multiple endpoints. A GTE > 0 indicated a more favourable global treatment response to riluzole than placebo. **Results:** Our analysis included 290 patients (mean age 5 yr [standard deviation (SD) 10.1 yr], 129 females (44%). Of these, 141 received riluzole and 149 received placebo. Riluzole demonstrated significantly higher GTE than placebo at 1 year (GTE 0.08 [SD 0.04], p = 0.02). A similar favourable global response was identified at 35 days and 6 months (GTE 0.07, p = 0.04). Riluzole-treated patients had a 54% higher likelihood of improved outcomes at 6 months. The combination of ASIA motor score and NRS neck and arm pain ratings yielded the best-fit parsimonious model for detecting riluzole's greatest benefit (GTE 0.11 [SD 0.05], p = 0.007). **Conclusion:** This CSM-Protect trial reanalysis demonstrates that perioperative riluzole administration leads to overall clinical improvement compared to placebo, as measured by the GTE. Based on these data, clinicians may wish to consider riluzole as an adjunctive treatment for patients with DCM undergoing surgery.

D-41
Abstract ID 33

The growing problem of spine surgery wait times in British Columbia: longitudinal trends and impacts on perioperative outcomes. ***Jessica C.W. Wang, Raphaële Charest-Morin, Nicolas Dea, Charles Fisher, Marcel Dvorak, Brian Kwon, Tamir Ailon, Scott Paquette, John Street, Charlotte Dandurand.*** **From the Combined Neurosurgical and Orthopaedic Spine Program, University of British Columbia, Vancouver, B.C.**

Background: Surgical wait times for degenerative spinal disease are a growing problem in publicly funded health care systems. The impact of wait times on outcomes is unknown. Longitudinal trends of the different wait times remain uncharacterized. **Methods:** This was a single-centre retrospective analysis of prospectively collected data of patients who underwent elective spine surgery for degenerative spinal disease between 2009 and 2020. The wait time intervals assessed were T1 (between referral and initial consultation), Ti (between initial consultation to surgery booking) and T2 (between surgery booking and surgery date). Longitudinal wait time analyses were adjusted for age, sex, diagnosis and surgical volume. Results for patient outcomes were age- and sex-adjusted. **Results:** A total of 2041 patients had available wait time intervals. Total wait time (T1+Ti+T2) increased 8.1% annually ($p < 0.001$) between 2009 and 2020. T1 wait time decreased 4.3% annually ($p = 0.032$). T1 was not associated with adverse events or discharge disposition, but every 100 additional days of T1 was associated with 1.0% longer length of stay ($p = 0.001$). Ti wait time increased 21.0% annually ($p < 0.001$). For every 100 days of Ti, patients had a 2.3% increase in number of adverse events ($p < 0.001$), 2.9% increase in odds of experiencing an adverse event ($p = 0.002$) and 1.8% longer length of stay ($p < 0.001$). Every 100 days of Ti increased the odds of a patient being discharged home than elsewhere by 15.9% ($p < 0.001$). T2 wait time increased 7.0% annually ($p < 0.001$). T2 was not associated with adverse events. Every 100 days of T2 was associated with 11.6% longer duration of hospital stay ($p < 0.001$). There was a 76.5% increase in the odds of discharge home for every 100 days of T2. **Conclusion:** Wait times (T1+Ti+T2) for elective spine surgery significantly increased between 2009 and 2020. Ti increased most over the study period (ninefold) and was associated with a significant increase in adverse events and prolonged hospital stay. These worrisome data illustrate the overload of the health care system especially between initial consultation to surgery booking. These results will be crucial in planning future resource allocation.

D-42
Abstract ID 119

Patient expectations and surgical satisfaction in primary versus revision lumbar spine surgery. ***Rohail Mumtaz,[1,2] Khaled Skaik,[1,2,3] Eugene K. Wai,[1,2] Stephen Kingwell,[1,2] Alexandra Stratton,[1,2] Eve Tsai,[1,2] Philippe Tran Nhut Phan,[1,2] Zhi Wang,[4] CSORN Investigators.[5]*** **From the [1]Civic Campus, Ottawa Hospital, Ottawa, Ont.; the [2]University of Ottawa, Ottawa, Ont.; [3]McGill University, Montréal, Que.; [4]Centre hospitalier de l'Université de Montréal, Montréal, Que.; the [5]Canadian Spine Society, Markdale, Ont.**

Background: Patient expectations can influence spine surgery outcomes and satisfaction, but unmet expectations can lead to dissatisfaction. This study aims at investigating the relationship between patient expectation, satisfaction and patient-related outcome measures (PROMs). We hypothesized that primary and revision lumbar surgery patients have different expectations that might influence patient satisfaction. **Methods:** Using the Canadian Spine Outcomes and Research Network (CSORN) and degenerative lumbar spondylolisthesis registries, we grouped patients into primary or revision surgeries. We collected pre-surgery PROMs, which included EuroQol-5D (EQ-5D), pain scores and surgical expectations across 6 dimensions. At 1 year, patient satisfaction was assessed using a 5-point Likert scale. Differences in expectations, pain scores, and Oswestry Disability Index (ODI) and EQ-5D scores at 1 year and baseline were computed to compare the surgery groups. **Results:** One year after surgery, both groups exhibited a substantial number of fulfilled expectations and positive changes in PROMs scores ($p < 0.0001$). Expectations for revision surgery patients were met or surpassed to a greater extent compared to the primary group, notably regarding back and leg pain. In the revision group, 32% expected back pain to be "better," with 49% achieving it (17% gain) at 1 year. For leg pain, 30% expected to be "better" and 41% achieved it (11% gain), surpassing primary group improvements of 11% and 10%, respectively. However, satisfaction was higher for the primary group (60.42%) than the revision group (47%) ($p < 0.0001$). Mean EQ-5D score (± standard deviation) was 71.65 (± 18.19) in the primary cohort, greater than the 66.39 (± 19.58) ($p < 0.0001$) in the revision cohort, with a greater change from baseline to the 1-year mark in the primary cohort 15.85 (± 23.53) ($p < 0.0001$). Mean ODI score was lower in the primary cohort (24.56 [± 18.98]) than for their revision surgery counterparts (33.94 [± 19.38]), with a greater decrease from baseline to 1 year (–21.73, $p < 0.0001$), and overall better PROMs. **Conclusion:** PROMs scores are more likely to influence patient satisfaction since satisfaction was higher in the primary surgery group, correlating with better PROMs scores, while revision surgery patients were less satisfied, with lower PROMs scores, despite met or exceeded expectations. This underscores the importance of understanding and managing patient expectations.

D-43
Abstract ID 105

Impact of surgical wait time on prescription opioid utilization in patients having surgery for degenerative spinal conditions. ***Ragavan Manoharan,[1] Greg McIntosh,[2] Yoga R. Rampersaud.[3]*** **From the [1]Royal North Shore Hospital, Sydney, Australia; the [2]Canadian Spine Outcomes and Research Network, Toronto, Ont.; the [3]Toronto Western Hospital, Toronto, Ont.**

Background: The objective was to assess the impact of wait time for elective spinal surgery on prescription opioid utilization in patients with degenerative spinal conditions. **Methods:** A retrospective review of prospectively collected data in the Canadian Spine Outcomes and Research Network (CSORN) registry. Patients having elective surgery for degenerative conditions were divided into groups based on preoperative and 1-year postoperative prescription opioid utilization. Cumulative

wait time (CWT) was defined as the time from referral to surgery and was stratified into subgroups (≤ 6 mo and > 6 mo). Additional data collected included patient demographics, socioeconomic factors, surgical procedural information and outcome indices. Associations between subgroups were explored with logistic regression analyses. **Results:** In all, 4338 patients were included, of whom 2120 (48.9%) were using prescription opioids prior to surgery. At 1 year after surgery, 22.4% of patients were using opioids, including 18% who remained users and 4.4% who changed from nonusers to users. The mean CWT was 376 days. In patients who were utilizing opioids prior to surgery, ongoing opioid utilization at 1 year postoperatively was more commonly seen in patients with a CWT > 6 months (19.6% v. 15.2%, $p < 0.001$). Similarly, a CWT ≤ 6 months was associated with a greater portion of patients changing from user to nonuser at 1 year (34.3% v. 28.9%, $p < 0.001$). CWT had no impact on the proportion of patients who never used (46.4% v. 46.9%, $p = 0.777$) or on the small percentage of patients who changed from nonuser to user (4.1% v. 4.6%, $p = 0.448$). After adjusting for baseline differences between groups (sex, diagnosis, symptom duration and severity, and claims status), the odds of not using opioids postoperatively were greater in those with a CWT ≤ 6 months (odds ratio 1.2, $p = 0.021$). **Conclusion:** Almost half of all patients having elective spine surgery for degenerative conditions were on prescription opioids prior to surgery and 1 in 5 were on opioids at 1 year after surgery. CWT ≤ 6 months was independently associated with a greater odds of not using opioids after surgery.

D-44
Abstract ID 108

Emergency department "bounce backs" after posterior decompression surgery. ***Jenna Smith-Forrester, JoAnne E. Douglas, Evan Nemeth, Jacob Alant, Sean Barry, Andrew Glennie, William Oxner, Lutz Weise, Sean Christie*. From Dalhousie University, Halifax, N.S.**

Background: Emergency department (ED) crowding has become an epidemic in Canada, and the assessment of postoperative "bounce backs" after spinal surgery is a critical aspect of both quality assurance and improvement efforts. Laminectomies and discectomies are among the most common surgical interventions for various spinal pathologies. Our primary objective was to identify bounce-back patterns and potential areas for improvement in patient education and management, ultimately reducing the likelihood of presentation to the ED. **Methods:** All provincial ED data sets (EDIS, STAR and Meditech) were queried over 6 fiscal years to identify patients presenting within 90 days of spine surgery. Identification of surgical procedures was completed using Canadian Classification of Health Interventions codes 1SC80 and 1SE87. A detailed chart review was conducted for each patient who rebounded to any provincial ED within 90 days of a laminectomy/discectomy. The reason for presentation to the ED was categorized as unrelated (medical) or related (surgical) to the procedure. **Results:** Between Apr. 1, 2016, and Mar. 31, 2022, a total of 1032 laminectomies and 1133 discectomies were performed in 990 and 1036 patients, respectively. A total of 912 ED visits ($n = 448$ postlaminectomy and 464 postdiscectomy) occurred within 90 days of 2165 surgeries. In all, 42.6% of ED visits were categorized as medical and 57.4% as surgical. For ED visits related to the surgery, wound care (28.0%), pain management (26.5%) and bladder issues (17.9%) were the most common reasons for presentation. Drainage from the incision (serous or blood) and routine wound checks accounted for 59.1% and surgical site infections for 27.2% of visits related to the wound. Patients presenting with pain as a primary symptom were discharged home with additional pain medications in 69.1% of cases, whereas 26.0% of patients presented in a pain crisis required hospital admission. **Conclusion:** A significant number of patients present to the ED following spine surgery. Multiple areas of care improvement have been identified. Immediate initiatives should be focused on postoperative education, pain management and system change to facilitate wound management.

D-45
Abstract ID 21

Can patients with cerebrospinal fluid leak be discharged home on the same day after tubular microdiscectomy: retrospective cohort analysis. ***Eva Y. Liu,[1] Amit R.L. Persad,[1,2] Sabahat Saeed,[1] Patrick Toyota,[1] Jack Su,[1] Braeden Newton,[1] Nicole Coote,[1] Daryl Fourney.[1]* From the [1]University of Saskatchewan, Saskatoon, Sask.; and [2]Stanford University, Palo Alto, Calif.**

Background: Cerebrospinal fluid (CSF) leak is a common complication of minimally invasive tubular microdiscectomy. However, it is not known in the literature whether patients with cerebrospinal fluid can be safely discharged home the same day. **Methods:** This was a retrospective cohort study of 30 patients who had dural tear or CSF leak after minimally invasive tubular microdiscectomy from Jan. 1, 2009, to Aug. 31, 2023. Demographic information including age, sex and smoking status, and surgical factors including spinal levels, type of operation, revision surgery status, duraplasty techniques and any products used were recorded. Postoperative data including admission status, length of hospital stay, length of bedrest, any CSF leak symptoms and any revision surgery for CSF leak repair were also collected. **Results:** The mean age of the included patients was 60.3 (14.9) years, and 11 (36.7%) were female. There were 16 patients (53%) who were admitted to hospital and 14 (47%) patients discharged home the same day after CSF leak. The average length of stay for the hospitalized group was 2.4 (± standard deviation 4.0) days. Twenty-nine patients (97%) had only duraplasty, and 1 patient (3%) underwent repair using sutures. Twenty-two patients (73%) also had fibrin sealant placed. One patient from the hospital admission group presented with symptoms consistent with cauda equina syndrome and magnetic resonance imaging evidence of epidural hematoma requiring emergency open laminectomy and evacuation of hematoma. One patient from the same-day discharge group had low-pressure headaches postoperatively, which were successfully managed with conservative measures as an outpatient. **Conclusion:** Patients with CSF leak after minimally invasive tubular microdiscectomy can be safely discharged home the same day provided that duraplasty or primary repair with or without fibrin sealant was performed intraoperatively.

D-46
Abstract ID 42

Efficacy of virtual triage in patients with low back pain. ***Maria S. Rachevits, Helen Razmjou, Susan Robarts, Albert Yee, Joel Finkelstein*. From the Sunnybrook Health Sciences Centre, Toronto, Ont.**

Background: Reduced access to specialty clinics expanded the use of virtual consultations via telemedicine during the COVID-19 pandemic. This study examined the efficacy of the virtual platform for screening and triaging patients and assessing the need for an in-person consult. **Methods:** This was an observational study of patients with low back and/or leg pain referred to a spine clinic. A telephone interview was conducted by an experienced advanced practice physiotherapist (APP). Patients with red flags (cauda equina syndrome, metastatic lesions, infection, fractures) were excluded. The following questionnaires were emailed to patients: Back versus leg pain (Wei et al., 2009), self-reported history questionnaire (4 questions, Konno et al., 2007), Oswestry Disability Index (ODI) and STarT Back. Instructions on performing the 5-Repetition Sit-to-Stand test were included. The magnetic resonance imaging report was reviewed by the APP, and the presence of any relative pathology was recorded for analysis. **Results:** The sample consisted of 100 consecutive patients (50 females [50%], average age 58 yr [standard deviation 16 yr, range 20–87 yr]). Of the 100 participants, 40 required an in-person assessment, 35 by a surgeon (33 by a spine surgeon and 2 by a hip surgeon) and 5 by the APP. Twenty-seven patients needed a second telephone follow-up by the APP. Therefore, 60% did not require an in-person visit to the clinic. The most prominent reason for in-person consultation with the surgeon was leg dominant pain (radiculopathy) with concordant imaging findings (27 patients [77%]). There were 5 cases (14%) with signs of unstable spondylolisthesis in this group, and 2 cases (6%) of end-stage hip osteoarthritis requiring hip replacement. The relationship between the risk categories of ODI and STarT Back was significant ($p < 0.0001$); the isolated scores of ODI, STarT Back and Sit-to-Stand test did not correlate with surgical candidacy ($p > 0.05$). **Conclusion:** Important components of clinical assessment could be obtained via a structured virtual telephone encounter. Telemedicine offers an efficient alternative method of triaging low back referrals even in nonpandemic times.

D-47
Abstract ID 54

Wait times and health resource utilization by patients awaiting spine assessment and surgery in Manitoba. ***Alysa Almojuela*,[1] *Frederick Zeiler*,[1] *Sarvesh Logsetty*,[2] *Perry Dhaliwal*.[1] From the [1]Section of Neurosurgery, University of Manitoba, Winnipeg, Man.; the [2]Section of Plastic Surgery, University of Manitoba, Winnipeg, Man.**

Background: Prolonged wait times for spine care pose significant burdens to patients, health care providers, and hospital and government administration. We sought to assess wait times and health resource utilization by patients awaiting spine assessment and/or surgery in Manitoba, and to compare this before and after the COVID-19 pandemic was declared in 2020. **Methods:** A retrospective review of patient records and administrative databases was performed to identify adult spine patients electively referred to spine subspecialty care from Sept. 1, 2017, to June 31, 2021. We measured wait times from referral to assessment and surgery, and health care utilization in the form of spine-related emergency department (ED) visits, spine-related physician visits, pain-related spinal procedures, spinal diagnostic imaging tests and opioid dispensation. Poisson regression was used to test the relationship between longer wait times and health care utilization. **Results:** A total of 11 348 patients were electively triaged during this time period. The median wait time to consult/assessment was 153 days ($n = 6336$), and the median wait time to surgery was 185 days ($n = 806$). The number of patients waiting for consult/assessment rose from 240 in 2017 to 6203 in 2021. Wait times, diagnostic imaging use, opioid dispensation and physician-related visits increased over the study period. There were significantly more spine-related ED visits, physician visits, spinal diagnostic imaging tests and opioids dispensed after the COVID-19 pandemic was declared. Among patients still awaiting consult/assessment, longer wait times were significantly associated with more outpatient physician spine-related visits, pain-related spinal procedures, diagnostic imaging use and opioid dispensation ($p < 0.001$). **Conclusion:** Wait times in Manitoba to access spine care steadily increased over time and were exacerbated by the COVID-19 pandemic. Longer wait times were associated with higher rates of health resource utilization, including outpatient physician visits, diagnostic imaging tests and opioid dispensation. Understanding the magnitude of this problem allows the development of a targeted strategy toward improving the delivery of spine care in Manitoba.

D-48
Abstract ID 165

Characteristics of attrition of patients enrolled in the Canadian Spine Outcomes and Research Network registry and prospective studies for degenerative spine surgery. ***Mark Abdelnour*,[1] *Yuxin Zhang*,[1] *Eugene Wai*,[1] *Stephen P. Kingwell*,[1] *Alexandra Stratton*,[1] *Eve Tsai*,[1] *Philippe T. Phan*,[1] *CSORN Investigators*.[2] From the [1]University of Ottawa, Ottawa, Ont.; the [2]Canadian Spine Society, Markdale, Ont.**

Background: A notably elevated prevalence of patients lost to follow-up (attrition) following degenerative spine surgery has been observed in spinal registries worldwide. However, characteristics of the attrition population in the Canadian Spine Outcomes and Research Network (CSORN) registry remain unknown. This study aimed to examine factors associated with attrition prevalence, to compare attrition in CSORN retrospective registries and prospective degenerative spondylolisthesis (LDS) and cervical spondylotic myelopathy (CSM) cohorts, and to analyze attrition prevalence at different time points. **Methods:** Patients from the CSORN retrospective registry and prospective cohorts (LDS and CSM) were included. Attrition was defined as the failure to complete all postoperative assessments and questionnaires at a specific time point. Univariable logistic regression assessed the correlation between attrition and specific demographic variables. Pearson's χ^2 test was used to compare attrition between prospective cohorts and the retrospective registry, and between 3 months, 12 months and 24

months after surgery. **Results:** There were 5567 patients included from the registry, and 366 and 721 from the LDS and CSM cohorts, respectively. The overall attrition rate at 1 year was 21.9%. The rates for the CSORN registry and the LDS and CSM cohorts were 1236 (22.69%), 58 (15.85%) and 136 (18.87%), respectively. Therefore, the prevalence of attrition in the LDS and CSM cohorts was significantly lower than in the CSORN registry ($p = 0.003$ and $p < 0.001$, respectively). Factors such as male gender, young age, smoking, nonmarried, nonworking, decrease in EuroQol-5D (EQ-5D) score, and increase in Patient Health Questionnaire module 9 (PHQ-9), Oswestry Disability Index and American Society of Anesthesiologists (ASA) scores were all significantly associated with an increased prevalence of attrition. Loss to follow-up increased significantly over time (3 mo: 10.55%; 12 mo: 21.90%; 24 mo: 25.75%; $p < 0.001$ for all comparisons). **Conclusion:** Our study provides insight for spine surgeons and research teams to identify patients at risk for being lost to follow-up. Furthermore, evaluating the characteristics of Canadian patients lost to follow-up may further our understanding of the impact of attrition on the validity of spinal registries and their ensuing studies.

D-49
Abstract ID 67

Waiting for spine surgery in Canada: an evaluation of wait times, wait lists and surgeries performed before and after the onset of the COVID-19 pandemic. ***Taylor A. Smith*,[1,2,3] *Christopher Small*,[3,4,5] *Erin Bigney*,[2,3,4] *Eden Richardson*,[3,4] *Jillian Kearney*,[3,4] *Neil Manson*,[3,4,5] *Edward Abraham*,[3,4,5] *Najmedden Attabib*,[3,4,5] *Michael Bond*,[6] *Stephan Dombrowski*,[2] *Gwyneth Price*,[5,7] *Jose Manuel García-Moreno*,[8] *Jeffrey Hebert*.[2] From the [1]University of Manitoba, Winnipeg, Man.; the [2]University of New Brunswick, Fredericton, N.B.; the [3]Canada East Spine Centre, Saint John, N.B.; the [4]Horizon Health Network, Saint John, N.B.; [5]Dalhousie University, Saint John Campus, Saint John, N.B.; the [6]University of British Columbia, Vancouver, B.C.; [7]Memorial University, St. John's, N.L.; the [8]University of Murcia, Murcia, Spain.**

Background: The objective was to examine the impact of the COVID-19 pandemic on wait times for spinal surgery patients in Canada and quantify the number of patients waiting for spinal surgery and spinal surgeries performed. **Methods:** We included surgical patients who had provided consent from the 22 orthopedic or neurological surgical centres participating in the Canadian Spine Outcomes and Research Network (CSORN) registry. Study outcomes included wait times from surgical consultation to surgery (T2) and from general practitioner referral to surgery (T3), counts of patients on the wait list and surgeries performed. These outcomes were measured in 3-month intervals from Dec. 1, 2017, to Feb. 1, 2022. All cohorts were categorized by severity of their clinical condition as semi-urgent (myelopathy, fracture, infection, tumour, inflammatory spine disorder, spondylolisthesis type 4, 5 or 6, or motor impairments) or elective. Quantile regression was used to model the national change in T2 and T3 median days over time. We reported counts for patients waiting for surgery and surgeries performed. **Results:** The COVID-19 pandemic negatively impacted the national T2 and T3 wait times for elective and semi-urgent surgery patients. The number of patients on the waitlist for both surgical cohorts nearly doubled during the pandemic, and the number of surgeries performed during the pandemic fell. **Conclusion:** Evidence suggests a negative impact of the COVID-19 pandemic on wait times for elective and semi-urgent spinal surgery subgroups, a trend of increasing waitlists and decreasing spinal surgeries performed. These findings should inform future health care policies in the event of another disruptive health emergency and highlight the need to target the backlog of spinal surgeries. Future research should investigate the postpandemic environment to identify the persistence of surgical delay and its effects on spinal conditions.

D-50
Abstract ID 88

Words that lead to the operating room: identifying terminology patterns in referral letters for lower back pain and their association with surgery using Natural Language Processing. ***Steven Qiu*, *Vithushan Surendran*, *Victoria Shi*, *Emily Cheung*, *Sophie Ngana*, *Muhammad A. Qureshi*, *Sunjay V. Sharma*, *Markian Pahuta*, *Daipayan Guha*. From McMaster University, Hamilton, Ont.**

Background: The objective was to identify patterns in referral letters for lower back pain associated with surgical intervention using natural language processing (NLP). **Methods:** We retrospectively reviewed the charts of patients who were referred for lower back pain to our spinal surgical group at Hamilton Health Sciences via a central intake centre with standardized lower back pain assessment. We identified patients with referral letters in fully digital formats who had already been assessed by a spine surgeon for surgical candidacy. Referral letter text for each patient was scraped, de-identified and processed using the NLP Python library "NLTK," then analyzed for commonly occurring terms/phrases. Such terms/phrases were analyzed across all patients for their association with surgery as the final recommendation using χ^2 tests. **Results:** In total, 243 patients fit our data criteria, 141 of whom were surgical. Across all patients, terms/phrases that were most strongly associated with a recommendation for surgery were "severe spinal canal" (odds ratio [OR] 12.3, $p < 0.001$), "walker" (OR 11.9, $p = 0.007$), "heaviness" (OR 9.32, $p = 0.02$), "conservative measures" (OR 8.5, $p = 0.03$) and "tolerance of less [than 5 minutes]" (OR 5.5, $p = 0.03$). Interestingly, "right buttock" (OR 0.3, $p = 0.02$) was negatively associated with surgery, while there was no corresponding association with "left buttock." **Conclusion:** Our preliminary data suggest that there exists certain terminology in referral letters for lower back pain that are associated with a higher chance of the patient being a surgical candidate. Although using a single centralized source for the referral letter minimizes the errors during NLP analysis, it also limits the generalizability of these findings, as biases in the language used by the central intake personnel may be reflected in the detected patterns. Furthermore, terms/phrases in isolation sometimes fail to capture semantics (e.g., "no pain" and "pain" both have the term "pain"). Additional investigation using a variety of sources along with a larger sample size is needed, and more complex NLP methods for semantics are required.

E-51
Abstract ID 38

Quantifying the association between surgical spine approach and tracheostomy timing after traumatic cervical spinal cord injury. ***Ahmad Essa,[1] Husain Shakil,[1] Armaan Malhotra,[1] James Byrne,[2] Jetan Badhiwala,[3] Eva Yuan,[1] Yingshi He,[1] Andrew Jack,[3] Francois Mathieu,[4] Jefferson R. Wilson,[1] Christopher D. Witiw.[1]*** **From the [1]Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ont.; the [2]Department of Surgery, Johns Hopkins Hospital, Baltimore, Md.; the [3]Division of Neurosurgery, University of Alberta, Edmonton, Alta.; the [4]Interdepartmental Division of Critical Care, University of Toronto, Toronto, Ont.**

Background: The objective was to evaluate the influence of spine surgical approach on the association between tracheostomy timing and in-hospital adverse events in patients with complete cervical spinal cord injury (SCI). **Methods:** This retrospective observational cohort study was performed using American College of Surgeons Trauma Quality Improvement Program data obtained from 2017 to 2020. All patients with acute complete (American Spinal Cord Injury Association grade A) traumatic cervical SCI who underwent tracheostomy and spine surgery were included. Primary outcome was occurrence of major in-hospital complications. Secondary outcomes included the occurrence of immobility-related complication, surgical site infection, hospital length of stay (LOS), intensive care unit (ICU) LOS and number of days requiring ventilator. **Results:** The study included 1592 patients; 495 patients underwent surgery by anterior approach, 670 by posterior approach and 427 by combined anterior and posterior approach. Early tracheotomy was found to be associated with a significant reduction in major in-hospital complications (odds ratio [OR] 0.67, 95% confidence interval [CI] 0.53 to 0.84) and immobility complications (OR 0.78, 95% CI 0.6 to 1.0). Those undergoing early tracheostomy spent 6.0 (95% CI –8.47 to –3.43) fewer days in hospital, 5.7 (95% CI 7.8 to 3.7) fewer days in the ICU and 5.9 (95% CI 8.2 to 3.7) fewer days on a ventilator. Surgical approach had no significant negative effect on the association between tracheostomy timing and any of the outcomes of interest. **Conclusion:** Earlier tracheostomy for patients with traumatic cervical SCI is associated with reduced likelihood of complications, LOS, ICU LOS and time spent on ventilator. This relationship appears independent of the choice of surgical approach. These findings emphasize that tracheostomy need not be delayed owing to the approach used for treatment of traumatic cervical SCI.

E-52
Abstract ID 25

Withdrawal of life-supporting treatment in spinal cord injury: a large multicentre observational cohort study. ***Husain Shakil,[1] Armaan K. Malhotra,[1] Eva Yuan,[1] Christopher W. Smith,[1] Erin M. Harrington,[1] Rachel H. Jaffe,[1] Alick P. Wang,[2] Karim Ladha,[1] Avery B. Nathens,[1] Jefferson R. Wilson,[1] Christopher D. Witiw.[1]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]University of Ottawa, Ottawa, Ont.**

Background: There are limited studies on factors associated with the decision to withdraw life-supporting treatment (WLST) in patients with traumatic spinal cord injury (SCI). In this study we aimed to identify patient, injury and health service factors associated with WLST in those with traumatic SCI. **Methods:** We conducted a multicentre observational study utilizing data collected from trauma centres through the American College of Surgeons Trauma Quality Improvement Program between 2017 and 2020. We included adult patients (> 16 yr) with complete cervical SCI and a documented decision for WLST. We constructed a multilevel mixed-effects logistic regression model to adjust for patient, injury and hospital factors influencing WLST. Factors associated with WLST were estimated through odds ratios with 95% confidence intervals (CIs). Hospital variability was characterized using the median odds ratio (MOR). Unexplained residual variability was assessed through the proportional change in variation between models. **Results:** We identified 5070 patients with complete cervical SCI treated across 477 hospitals, of whom 960 (18.9%) had WLST. Patient-level factors associated with significantly increased likelihood of WLST were advanced age, male sex, White ethnicity, prior dementia, low presenting Glasgow Coma Scale score, prehospital cardiac arrest, a spinal cord injury level of C3 or above, and concurrent severe injury to the head or thorax. Patient-level factors associated with significantly decreased likelihood of WLST included being Black or Asian. There was significant variability across hospitals in the likelihood for WLST while accounting for case-mix, hospital size and teaching status (MOR 1.51, 95% CI 1.22–1.75). **Conclusion:** A notable proportion of patients with complete cervical SCI undergoes WLST during their in-hospital stay. We have highlighted several factors associated with this decision and identified considerable variability among hospitals. Further work to standardize WLST guidelines may improve equity of care provided to this patient population.

E-53
Abstract ID 34

Comparative analysis of spinal cord–derived endogenous stem cells and induced pluripotent stem cells for spinal cord injury treatment. ***Ryan V. Sandarage,[1] Ahmad Galuta,[1] Eve C. Tsai.[1,2]*** **The [1]University of Ottawa, Ottawa, Ont; the [2]Ottawa Hospital, Ottawa, Ont.**

Background: The emergence of induced pluripotent stem cells (iPSCs) has ushered in new possibilities for spinal cord injury (SCI) treatment by enabling the generation of neural stem/progenitor cells (NSPCs). Nevertheless, a comprehensive understanding of how iPSC-derived NSPCs compare to genuine spinal cord NSPCs in molecular and functional terms remains elusive. Our study aimed to provide in-depth characterization of bona fide spinal cord NSPCs in comparison to their isogenic iPSC-derived counterparts, which have been regionally specialized for the spinal cord (iPSC-SC) and the brain (iPSC-Br). **Methods:** We obtained human spinal cord and skin tissue with ethics approval, subsequently establishing primary NSPC cultures. From these primary cells, we derived iPSCs and differentiated them into iPSC-Br and iPSC-SC NSPCs. We assessed these cells for various characteristics, including their differentiation and proliferation capabilities, using immunostaining and

statistical analyses. Furthermore, RNA sequencing was performed on bona fide NSPCs, iPSC-Br NSPCs and iPSC-SC NSPCs, with data analysis to identify differential gene expression and functional changes. **Results:** Our findings revealed substantial differences in the functional and transcriptional properties of bona fide NSPCs when compared to iPSC-SC and iPSC-Br NSPCs. Both bona fide and iPSC-SC NSPCs exhibited spinal cord regionalization, while iPSC-Br NSPCs displayed a dorsal forebrain regionalization. Notably, both iPSC-derived NSPCs shared functional and transcriptional features characteristic of early developmental stages, including genes associated with embryonic patterning and heightened proliferation rates. Moreover, differentiation profiles were most similar between bona fide and iPSC-Br NSPCs, whereas significant differences were observed between bona fide and iPSC-SC NSPCs. **Conclusion:** Our study uncovered distinct regional, developmental and functional characteristics between bona fide spinal cord NSPCs and iPSC-derived NSPCs. Addressing these disparities has the potential to enhance the clinical efficacy of iPSC-derived NSPC therapies for spinal cord injuries. By shedding light on the unique qualities of these 2 cell types, our findings contribute to a deeper understanding of their potential applications in the realm of spinal cord injury treatment and regenerative medicine.

E-54
Abstract ID 65

Specialized care is associated with reduced risk for unplanned readmissions following traumatic incomplete spinal cord injury. ***Naama Rotem-Kohavi,[1] Marcel F. Dvorak,[2] Jijie Xu,[1] Nader Fallah,[1] Zeina Waheed,[1] Melody Chen,[1] Nicolas Dea,[2] Nathan Evaniew,[3] Vanessa Noonan,[1] Brian Kwon.[2]*** **From the [1]Praxis Spinal Cord Institute, Vancouver, B.C.; the [2]University of British Columbia, Vancouver, B.C.; the [3]University of Calgary, Calgary, Alta.**

Background: Specialized centres (SCs) that provide acute and rehabilitation care for traumatic spinal cord injuries (tSCI) aim to optimize patient care and outcomes. Although some studies suggest reduced mortality and reduced pressure injury risk, there is little evidence on SC impact. This study aimed to determine if SC admission reduces unplanned readmission (UR) risk within 1 year after discharge following acute incomplete tSCI. **Methods:** Administrative health care data sets from Population Data BC were linked to the Rick Hansen Spinal Cord Injury Registry to identify individuals with incomplete tSCI between 2001 and 2017 (using *International Statistical Classification of Diseases and Related Health Problems, 10th revision* codes). We examined their UR to acute care hospital following discharge from final acute/rehabilitation care for their initial tSCI hospital admission. An unadjusted bivariate analysis (χ^2/Kruskal–Wallis test) was conducted to describe individuals admitted to an SC compared to those admitted to a nonspecialized centre. Subsequently, we performed multivariable logistic regression to adjust for covariates and determine associations between UR risk and care centre type. For validation, we used a Cox regression and propensity score matching. **Results:** In all, 1920 patients were included in the analysis. Individuals admitted to an SC were younger (mean 50.7 yr [standard deviation (SD) 18.8 yr] v. 57 [SD 19.2] yr), had more spine surgeries (62% v. 35%), longer total stay including acute and rehabilitation (55.0 d [95% confidence interval (CI) 14.0–123.0 d] v. 13.0 [95% CI 5.0–46.0] d), less direct admissions 36.6% v. 93.9%, $p < 0.05$) and fewer URs (15.5% v. 17.8%, $p = 0.178$). Multivariable logistic regression adjusting for age, sex, Injury Severity Score, neurological level, comorbidities, time to admission, discharge destination, direct/indirect transfer, traumatic brain injury, previous UR, spine surgery and total length of stay demonstrated that type of care was associated with reduced UR risk (odds ratio 0.67, 95% CI 0.46–0.96, $p = 0.028$). Cox regression and propensity score matching indicated a consistent finding (hazard ratio 0.72, 95% CI 0.52–0.98, $p = 0.0395$ and $\chi^2 = 0.046$). More comorbidities, prior UR and longer stay were associated with increased UR risk ($p < 0.05$). **Conclusion:** Individuals with incomplete tSCI admitted to an SC have 33% lower odds of UR within 1 year after discharge than those admitted to a nonspecialized centre. Better understanding of the factors associated with reduced UR risk may inform targeted interventions.

E-55
Abstract ID 113

The association between mean arterial blood pressure augmentation and intraparenchymal hemorrhage after acute spinal cord injury. ***Brian K. Kwon, Toluyemi Malomo, Raphaële Charest-Morin, Scott Paquette, Tamir Ailon, Charlotte Dandurand, John Street, Charles G. Fisher, Nicolas Dea, Manraj Heran, Marcel Dvorak.*** **From the University of British Columbia, Vancouver, B.C.**

Background: Acute traumatic spinal cord injury (SCI) results in microvascular disruption and intraparenchymal hemorrhage (IPH), which is viewed as a bad prognostic sign when seen on magnetic resonance imaging (MRI). Additionally, the blood itself (and its breakdown products) are deleterious to the neural tissue and may increase secondary damage. Therefore, approaches that increase such IPH may be deleterious for recovery. Mean arterial blood pressure (MAP) augmentation to maintain MAP between 85 and 90 mm Hg for 7 days is a routine part of acute SCI management, as per the 2013 Congress of Neurological Surgeons/American Association of Neurological Surgeons guidelines. The objective of this study was to evaluate the relationship between MAP augmentation and IPH during the first week after injury in patients with acute cervical SCI. **Methods:** Patients with acute cervical SCI were enrolled at our level 1 trauma centre and underwent routine clinical MRI preoperatively and at 2 ,4, 7 and 14 days after injury. Axial and sagittal T_2-weighted images were used to quantify the extent of IPH. MAP augmentation with a target maintenance of 85–90 mm Hg was achieved with norepinephrine for 7 days after injury, and all MAP recordings were captured. A "time-weighted" average (TWA) of the MAP over the period between the baseline MRI and the subsequent MRIs was calculated in order to asses the "MAP exposure" of the injured spinal cord between imaging studies. **Results:** Twelve patients with cervical SCI have been enrolled; at the baseline time point, all patients demonstrated IPH. On days 2

and 4, the extent of IPH progressed, followed by a reduction in the IPH area on days 7 and 14. During the first 48 to 96 hours after injury, TWA-MAP significantly correlated with change in IPH ($p < 0.05$), with MAP above ~86 mm Hg associated with an increase in IPH. **Conclusion:** By performing serial MRIs in the early postinjury period, we have established that patients who have signs of IPH at the time of their presentation may have worsening hemorrhage with MAP augmentation. These findings have important implications for acute SCI management and may help to tailor hemodynamic management recommendations.

E-56
Abstract ID 27

Impact of traumatic cervical spinal cord injury on income and employment status in a Canadian cohort. ***Rachael Jaffe,[1] Peter Coyte,[1] Brian Chan,[2] Armaan Malhotra,[1,3] Rebecca Hancock-Howard,[1] Jefferson Wilson,[1,3] Christopher Witiw.[1,3]*** **From the [1]University of Toronto, Toronto, Ont.; [2]KITE — Toronto Rehabilitation Institute, Toronto, Ont.; [3]St. Michael's Hospital, Toronto, Ont.**

Background: Spinal cord injury (SCI) causes drastic changes to an individual's physical health that can affect their ability to work. The objective was to estimate the impact of SCI on individual earnings and employment status using national administrative health databases linked to income tax data. **Methods:** This is a retrospective, national, population-based cohort study of adults who were hospitalized with cervical SCI in Canada between January 2005 and December 2017. All acute care hospitalizations for SCI of adults between the ages of 18 and 64 identified by their *International Statistical Classification of Diseases and Related Health Problems*, *10th revision*, Canadian version codes were included. The comparison group was identified from our main cohort at least 6 years prior to injury. The main cohort was matched with the comparison group based on age, sex, marital status, province of residence, self-employment status, earnings and employment status in the year prior to injury, and the year of the index event. The first primary outcome was individual annual earnings up to 5 years after injury. The change in mean yearly earnings was assessed using a linear mixed-effects differences-in-differences regression. The second primary outcome was the change in employment status up to 5 years after injury. A multivariable probit regression model was used to compare proportions of individuals employed between those with SCI and the paired comparison group of participants. **Results:** A total of 1630 patients with SCI were matched to a pre-injury comparison group. The mean pre-injury wage was $46 000 (standard deviation $48 252) in 2022. The annual decline in individual earnings in the 5 years following injury ranged between –$20 275 in Y–1 and –$20 348 in Y+5. Five years after injury, 52% of those who had an injury were working, compared to 79% of the pre-injury comparison group. In the fifth year after injury, the SCI survivors saw a decrease in employment of –17.8 percentage points. **Conclusion:** SCI was shown to be significantly associated with a decline in earnings and employment up to 5 years after injury for adults aged 18–64 years in Canada.

E-57
Abstract ID 37

Circuit interrogation of whole brain reveals a novel neuromodulatory target to improve locomotion after traumatic spinal cord injury. ***Newton Cho,[1,2] Jordan Squair,[1,2] Viviana Aureli,[1,2,3] Nicholas James,[1,2] Lea Bole-Feysot,[1,2] Inssia Dewany,[1,2] Nicolas Hankov,[1,2] Laetitia Baud,[1,2] Anna Leonhartsberger,[1,2] Kristina Sveistyte,[1,2] Michael Skinnider,[4] Matthieu Gautier,[1,2] Katia Galan,[1,2] Maged Goubran,[5] Jimmy Ravier,[1,2] Frederic Merlos,[1,2] Laura Batti,[6] Stéphane Pagès,[6] Nadia Bérard,[1,7] Nadine Intering,[1,7] Camille Varescon,[1,7] Stefano Carda,[7] Kay Bartholdi,[1,2] Thomas Hutson,[1,2] Claudia Kathe,[1,2] Michael Hodara,[1,2] Mark Anderson,[1,2] Bogdan Draganski,[7] Robin Demesmaeker,[1,2] Leonie Asboth,[1,2] Quentin Barraud,[1,2] Jocelyne Bloch,[1,2,3,7] Grégoire Courtine.[1,2,3,7]*** **From the [1]Defitech Center for Interventional Neurotherapies, Lausanne, Switzerland; the [2]NeuroX Institute, Lausanne, Switzerland; the [3]Department of Neurosurgery, Lausanne University Hospital, Lausanne, Switzerland; the [4]Lewis-Sigler Institute of Integrative Genomics and Ludwig Institute for Cancer Research, Princeton University, Princeton, N.J.; the [5]Department of Medical Biophysics, University of Toronto, Toronto, Ont.; the [6]Wyss Center for Bio and Neuroengineering, Geneva, Switzerland; the [7]Department of Clinical Neuroscience, Lausanne University Hospital, Lausanne, Switzerland.**

Background: Traumatic spinal cord injury (SCI) is a devastating condition that has few therapies to robustly improve neurological function. More recently, the use of neuromodulatory strategies including spinal epidural electrical stimulation (EES) has shown promise to activate lumbar spinal circuits and leg movement. However, our understanding of the brain's role in locomotion after SCI remains poor, with a paucity of therapies despite the effectiveness of brain modulation in other motor disorders such as Parkinson disease. The objective of this study was to understand how brain circuits change after SCI as a means to identify novel modulation targets to augment locomotion after SCI. **Methods:** We established an unbiased mouse brain interrogation pipeline including whole brain immunolabelling, clearing, imaging, atlas registration and cell quantification after SCI. In mice that underwent thoracic lateral hemisection, which robustly spontaneously recover leg function, we examined changes in whole brain c-Fos immunolabelling and rabies-mediated projection labelling to the lumbar cord to identify a brain region whose cell activity (c-Fos) and lumbar cord projections (rabies) correlated with recovery. We examined this region's functional role using optogenetics and chemogenetics. To assess therapeutic translatability, we then examined electrical deep brain stimulation (DBS) of this region in a more clinically relevant rat contusion model of SCI using a customized bipedal robotic interface. **Results:** Unexpectedly, the lateral hypothalamus (LH) demonstrated dynamic activity and connectivity changes correlating with mouse recovery after SCI. Mouse LH-VGluT2 neuronal optogenetic stimulation robustly improved locomotor function, and this effect was relayed via the brain stem medullary reticular formation (MRF). Consistent with sparing of MRF projections after contusion SCI, LH DBS robustly

augmented rat bipedal locomotion after contusion SCI. **Conclusion:** The LH is a novel DBS target whose stimulation significantly improved locomotion after SCI, uncovered through a whole-brain survey via a customized unbiased interrogation pipeline. This effect is dependent on LH VGluT2 neurons and brain stem relays. LH DBS may be a new therapy for humans with SCI, and its efficacy and safety require testing in clinical trials.

E-58
Abstract ID 118

Prediction of 5-year mortality following spinal cord injury using a frailty index as a measure of deficits. ***Sean D. Christie, Ryan Greene, Mustafa Nadi, Jacob Alant, Sean Barry, Andrew Glennie, Bill Oxner, Lutz Weise, Lisa Julien, Clara Lownie.*** **From Dalhousie University, Halifax, N.S.**

Background: Acute spinal cord injury (SCI) often leaves patients unclear about their long-term outcomes, especially morbidity and mortality. This is particularly true for older patients, and it may have an impact on treatment decisions. This study sought to determine if a lab-based frailty index (FI) could predict discharge destination and survival in hospital at 1 year and 5 years following SCI. **Methods:** All patients from a single Rick Hansen Spinal Cord Injury Registry site aged ≥ 50 years who experienced SCI between 2008 and 2017 were included in the study. An FI, as an "accumulation of deficits," was created from 38 laboratory and electrocardiogram values, commonly obtained in the trauma setting. The FI ranged from 0 to 1, with increasing values representing increased frailty. Sequential binary logistic regressions were performed, with the outcome of mortality during in-hospital stay, at 1 year and at 5 years. Age, sex, the American Spinal Cord Injury Association (ASIA) motor score and the FI were the covariates, and significance was observed at $p < 0.05$. **Results:** A total of 120 patients (88 male, mean age 67.03 yr [standard deviation 10.23 yr]) were included. Cumulative mortality was observed in hospital ($n = 12$), at 1 year ($n = 32$) and at 5 years ($n = 50$). In hospital, increasing FI significantly determined mortality ($p < 0.003$). At 1 year, increased age ($p = 0.005$) and higher FI ($p = 0.007$) significantly predicted mortality. At 5 years, increased age ($p < 0.001$), lower ASIA total motor score ($p = 0.029$) and higher FI ($p = 0.028$) contributed to odds of mortality. At 1 year, a formula of log odds (mortality) = –3.453 + 1.624 (Age) + 0.066 (FI), and at 5 years, a formula of log odds (mortality) = –2.251 –0.019 (ASIA) + 1.845 (Age) + 0.047 (FI) contributed to odds of mortality. Regarding discharge destination, 12.5% of patients went to long-term care, with the remainder being discharged home; lower ASIA total motor scores ($p = 0.015$) and higher FI ($p = 0.004$) contributed to increased odds of discharge to long-term care. **Conclusion:** Development of predictive factors that may determine mortality for patients who experience SCI could help facilitate informed decision-making for both caretakers and surgeons alike. Prediction of in-hospital, 1-year and 5-year mortality may also provide context for caregivers to understand what long-term outcomes may look like.

E-59
Abstract ID 125

Health economic analysis of neurologically intact thoracolumbar A3 and A4 fractures is dominant in supporting surgery over nonsurgical treatment. ***Marcel F. Dvorak,[1] Cumhur F.C. Öner,[2] Charlotte Dandurand,[1] Alexander Joeris,[3] Klaus Schnake,[4] Mark Phillips,[5] Alexander R. Vaccaro,[6] Richard Bransford,[7] Eugen Cezar Popescu,[8] Mohammed El-Sharkawi,[9] Shanmuganathan Rajasekaran,[10] Lorin M. Benneker,[11] Greg D. Schroeder,[6] Jin W. Tee,[12] John France,[13] Jérôme Paquet,[14] Richard Allen,[15] William F. Lavelle,[16] Emiliano Vialle,[17] Nicolas Dea.[1]*** **From the [1]University of British Columbia, Vancouver, B.C.; the [2]University Medical Centre, Utrecht, Netherlands; the [3]AO Foundation, Dübendorf, Switzerland; the [4]Waldkrankenhaus, St. Marien, Erlangen, Germany; [5]McMaster University, Hamilton, Ont.; the [6]Thomas Jefferson University Hospital, Philadelphia, Pa.; the [7]University of Washington, Seattle, Wash.; the [8]Oblu Emergency Hospital, Iasi, Romania; the [9]Assiut University, Assiut, Egypt; the [10]Ganga Hospital, Coimbatore, India; the [11]University of Bern, Bern, Switzerland; the [12]Alfred Hospital, Melbourne, Australia; the [13]West Virginia University, Morgantown, W.V.; [14]Université Laval, Québec, Que.; the [15]University of California, San Diego, Calif.; [16]SUNY Upstate Medical University, Syracuse, N.Y.; the [17]Cajuru University Hospital, Curitiba, Brazil.**

Background: Investigators have failed to demonstrate a benefit of surgical treatment as compared to nonsurgical care for patients with thoracolumbar A3/4 neurologically intact fractures. To our knowledge, a detailed health economic analysis has not been previously performed. Our objective was to determine the cost–utility of surgical treatment versus nonsurgical treatment of thoracolumbar burst fractures in neurologically intact patients from the AO Spine: TL A3 A4 Burst Fracture study from a societal perspective with 1-year, 2-year and working lifetime horizons. **Methods:** Utility scores and quality-adjusted life years (QALYs) were obtained from the 3-level EuroQol-5D (EQ-5D-3L) at 12 and 24 months after treatment. Direct and indirect costs were assessed from resource utilization data and patient diaries every 2 weeks. Costs were sourced from the literature and were adjusted to 2019 US dollars to account for inflation. The incremental cost-effectiveness ratio (ICER) was calculated by dividing the cost difference by the difference in QALYs between the 2 treatment groups. A discounting of 3% was applied for costs as well as utilities over time. **Results:** At 1 year, the difference in QALYs between the surgical and nonsurgical groups was 0.02, and the mean costs were US$32 247.77 (surgical) and $28 686.46 (nonsurgical), leading to an ICER of US$183 065.50 per QALY. At 2 years and over the working life of the patients, costs associated with work days lost and caregiver days off work increased with nonsurgical care. Medication use, and physiotherapy and chiropractic treatment were higher for nonsurgical patients. At 2 years, surgical treatment was dominant, with a mean cost difference of –US$579.57, with 0.02 difference in QALY, and an ICER of –US$28 978.50. Looking at the working lifetime horizon, the mean cost difference increased, and the cost savings with surgical treatment were –US$8680.26, i.e., surgical

treatment was again the dominant strategy, with an ICER of –US$25 530.18. **Conclusion:** A cost–utility analysis revealed surgery to be the dominant strategy as compared to nonsurgical treatment at 2 years following treatment and even more so over the working lifetime horizon from a societal perspective.

E-60
Abstract ID 49

Safety and feasibility of early activity-based therapy following traumatic spinal cord injury: final results from the PROMPT-SCI trial. ***Antoine Dionne,[1,2] David Magnuson,[3] Andréane Richard-Denis,[1,2] Yvan Petit,[4] Francis Bernard,[1,2] Dorothy Barthélémy,[1,5] Jean-Marc Mac-Thiong.[1,2,6]*** **From the [1]Université de Montréal, Montréal, Que.; the [2]Centre de Recherche de l'Hôpital du Sacré-Cœur de Montréal, Montréal, Que.; the [3]Department of Neurological Surgery, University of Louisville, Louisville, Ky.; the [4]Department of Mechanical Engineering, École de technologie supérieure de Montréal, Montréal, Que.; the [5]Centre for Interdisciplinary Research in Rehabilitation of Greater Montreal, CRIR, Montréal, Que.; the [6]Centre Hospitalier Universitaire Sainte-Justine, Montréal, Que.**

Background: Following traumatic spinal cord injury (tSCI), activity-based therapy (ABT) can stimulate neuroplasticity and promote neurofunctional recovery. Preclinical studies demonstrate that ABT is particularly effective when applied early after the injury. However, current practices limit the use of ABT to the rehabilitative phase. To our knowledge, the Protocol for rapid onset of mobilisation in patients with traumatic spinal cord injury (PROMPT-SCI) trial is the first attempt at implementing ABT within days of the injury. We present the final results on safety and feasibility. **Methods:** All adult patients who presented with a tSCI at a single level 1 trauma centre between April 2021 and July 2023 were screened. Patients were included if they met the following criteria: 1) neurological level of injury between C0 and L2; 2) American Spinal Injury Association Impairment Scale grade A, B or C; and 3) spinal surgery < 48 hours of the injury. The intervention consisted of daily 30-minute sessions of continuous passive in-bed leg cycling for 14 consecutive days, starting < 48 hours after surgery. Vital signs were monitored during sessions and adverse events were recorded. Neurological exams were performed daily. Participants' appreciation of the intervention was also evaluated with a questionnaire. **Results:** Of 45 participants, 32 (71%) achieved a full and safe session of cycling < 48 hours of surgery, and 43 (95.6%) managed to do so < 72 hours. The primary reason for not completing a full session < 48 hours was back pain secondary to the trauma and/or surgery. Other reasons were medical contraindications to cycling and conflicting patient schedules. Over the full 14-day course, 35 participants (77.8%) completed at least 11 (79%) of the 14 planned sessions. The reason for missing and/or failing to complete sessions was fatigue in most cases (> 85%). There were no adverse events or neurological deteriorations associated with sessions. Study participants had complication rates that were similar to those of retrospective controls. Appreciation of the intervention was excellent. **Conclusion:** Early ABT after severe tSCI is safe, feasible and acceptable in the acute care environment. Further work is required to evaluate its potential benefits for neurofunctional recovery and care pathway.

E-61
Abstract ID 107

Identification of proteins in the blood serum related to neurological recovery after traumatic spinal cord injury. ***Lukas Grassner,[1,2] Daniel Garcia-Ovejero,[3] Evelyn Beyerer,[4] Orpheus Mach,[2] Iris Leister,[2,5] Doris Maier,[2,5] Ludwig Aigner,[4,5] Angel Arevalo-Martin.[3]*** **From the [1]Department of Neurosurgery, Christian Doppler Clinic, Paracelsus Medical University, Salzburg, Austria; the [2]Spinal Cord Injury Center, BG Trauma Hospital, Murnau, Germany; the [3]Laboratory of Neuroinflammation, Hospital Nacional de Parapléjicos, SESCAM, Toledo, Spain; the [4]Institute of Molecular Regenerative Medicine, Paracelsus Medical University, Salzburg, Austria; [5]ParaMove, SCI Research Unit, BG Trauma Center Murnau, Murnau, Germany.**

Background: Biomarker discovery in spinal cord injury (SCI) is a rapid growing field that responds to the need of establishing an accurate diagnosis of severity and outcome prediction, but also to evaluate treatment response and elucidate mechanisms of damage that may lead to new therapeutic targets. Efforts have been mainly focused on the acute phase, but there is also a need to identify biomarkers in the subacute SCI window (from weeks to months), when sensorimotor recovery may still be expected and many secondary events develop in a variety of organs. Biomarkers derived from blood show many advantages, but the existence of a small set of high-abundant proteins (HAPs) masks the detection of many other low-abundant proteins (LAPs). **Methods:** We used sequential 2-stage depletion of HAPs with tandem IgY14–SuperMix columns to enrich LAPs in the serum of patients with SCI. We then compared the peptide and protein profiles between patients without significant neurological recovery and those with strong recovery, and validated some of these identified proteins using routine assay techniques (enzyme-linked immunosorbent assay). **Results:** Gene ontology pathways enrichment based on our peptidomics suggest higher coagulative and inflammatory states in patients without significant neurological recovery. We observed significantly higher levels of calumenin, SERPINE1 and ARHGAP35 in patients with strong recovery and significantly higher levels of CD300a and DEFA1 in patients with no significant recovery. **Conclusion:** Our study identified a set of LAPs as new biomarker candidates for neurological recovery and potential therapeutic targets to be explored in future studies.

E-62
Abstract ID 18

Critical appraisal of frailty and sarcopenia tools in spinal oncology. ***Mark Alexander MacLean,[1] Antoinette Charles,[2] Miltiadis Georgiopoulos,[3] Raphaële Charest-Morin,[4] Rory Goodwin,[2] Michael Weber.[3]*** **From [1]Dalhousie University, Halifax, N.S.; [2]Duke University, Durham, N.C.; [3]McGill University, Montréal, Que.; the [4]Vancouver General Hospital, Vancouver, B.C.**

Background: Frailty and sarcopenia predict worse surgical outcomes among spinal degenerative and deformity-related populations; this association is less clear in the context of spinal oncology. We sought to identify frailty and sarcopenia tools applied in

spinal oncology and appraise their clinimetric properties. **Methods:** A systematic review was conducted from Jan. 1, 2000, until June 2022. Study characteristics, frailty tools and measures of sarcopenia were recorded. Component domains, individual items, cut-off values and measurement techniques were collected. Clinimetric assessment was performed according to Consensus-based Standards for Health Measurement Instruments. **Results:** Twenty-two studies were included (42 514 patients). Seventeen studies utilized 6 frailty tools; the 3 most employed were the Metastatic Spine Tumor Frailty Index (MSTFI), Modified Frailty Index-11 (mFI-11) and mFI-5. Eight studies utilized measures of sarcopenia; the 3 most common were the L3-Total Psoas Area (TPA)/Vertebral Body Area (VBA), L3-TPA/Height^2 and L3-Spinal Muscle Index (L3-Cross-Sectional Muscle Area/Height^2). Frailty and sarcopenia measures lacked or had uncertain content and construct validity. Frailty measures were objective except the Johns Hopkins Adjusted Clinical Groups. All tools were feasible except the Hospital Frailty Risk Score (HFRS). Positive predictive validity was observed for the HFRS and in selected studies employing the mFI-5, MSTFI and L3-TPA/VBA. All frailty tools had floor or ceiling effects. **Conclusion:** Existing tools for evaluating frailty and sarcopenia among patients undergoing surgery for spinal tumours have poor clinimetric properties. We provide a pragmatic approach to utilizing existing frailty and sarcopenia tools until more clinimetrically robust instruments are developed.

E-63
Abstract ID 100

Early neurological recovery following surgical treatment of spinal cord injuries due to spinal tumours. A retrospective cohort study of 113 patients. ***Emile Brouillard*,[1,2] *Andréane Richard-Denis*,[1,2] *Antoine Dionne*,[1,2] *Ismail Laassassy*,[1,2] *Paul Khoueir*,[1,3] *Étienne Bourassa-Moreau*,[1,3] *Gilles Maurais*,[1,3] *Jean-Marc Mac-Thiong*.[1,2,4] From the [1]Université de Montréal, Montréal, Que.; the [2]Centre de Recherche de l'Hôpital du Sacré-Cœur de Montréal, Montréal, Que.; the [3]Hôpital du Sacré-Cœur de Montréal, Montréal, Que.; the [4]Centre de Recherche du CHU Sainte-Justine, Montréal, Que.**

Background: The impact of surgery on the neurological recovery of individuals with spinal cord injuries (SCIs) due to spinal tumours remains unclear, particularly for motor-complete injuries. This retrospective study assessed the early neurological improvement of 113 individuals who underwent surgery for SCI due to a spinal tumour. **Methods:** The neurological status was assessed before surgery and 1–3 weeks after spine surgery from the International Standards for Neurological Classification of Spinal Cord Injury. Early neurological recovery was determined from the perioperative improvement in neurological level of injury (NLI) and American Spinal Injury Association Impairment Scale (AIS) grade. The correlation between the neurological improvement and the delay from the onset of neurological symptoms to surgery was also assessed. **Results:** There were 63 males and 50 females. The mean age was 62.6 (standard deviation 14.5) years. NLI improved by 2 levels or more in 7 individuals (2 with AIS grade A, 1 with AIS grade B and 4 with AIS grade D). Of the 10 individuals with AIS grade A lesions, 9 improved by at least 1 AIS grade postoperatively (3 AIS grade B, 4 AIS grade C and 2 AIS grade D). All 5 individuals with AIS grade B lesions improved to AIS grade C after surgery. As for the 16 individuals with AIS grade C lesions, 10 improved to AIS grade D postoperatively. Of the 82 individuals with AIS D lesions, 13 became AIS grade E. There was no correlation between the improvement in NLI or AIS grade, and the delay from the onset of neurological symptoms to surgery. **Conclusion:** The great majority of individuals with SCI due to tumours, particularly those with motor complete injuries (90% of AIS grade A and 100% of AIS grade B lesions), improved neurologically within 3 weeks following surgical treatment. Regardless of the delay between the onset of neurological symptoms and initial presentation, surgery should be strongly considered in patients with SCI due to spinal tumours if they are medically fit for surgery.

E-64
Abstract ID 139

Cervical spine chordomas: surgical outcome assessment in a multicentre cohort from the Primary Tumor Research and Outcomes Network (PTRON). ***Julien Francisco Zaldivar-Jolissaint*, *Nicolas Dea*. From the University of British Columbia, Vancouver, B.C.**

Background: Chordomas are rare, locally aggressive and infiltrative primary neoplasms. Cervical spine localization of chordomas is rare and poses significant therapeutic challenges owing to the proximity to critical structures and the mechanical constraints of the mobile cervical spine. This prospective case series aimed to explore the clinical and patient-reported outcomes of surgically treated cervical chordomas in a large prospective multicentre cohort extracted from the AO Foundation Primary Tumor Research and Outcomes Network (PTRON) database. **Methods:** This study was a multicentre case series analysis utilizing data from the PTRON registry. The study population was restricted to patients with pathologically confirmed cervical chordomas involving C0–C7 who underwent surgical treatment in 1 of the participating centres and for whom both the initially planned and postoperatively pathologically confirmed surgical margins were documented. Patient demographics, overall survival, recurrence-free survival, neurological function, type of surgery, surgical margins, complications and adjuvant treatments received were retrieved. Patient-reported outcome assessment scores including the Spine Oncology Study Group Outcomes Questionnaire (SOSGOQ), EuroQol-5D (EQ-5D), 36-Item Short-Form Health Survey (SF-36), Numeric Rating Scale and Neck Disability Index were included. Statistical analysis was performed using multivariate analysis. **Results:** We identified 37 patients in the PTRON database fulfilling the eligibility criteria, of whom 11 benefited from en bloc resection and 18 benefited from intralesional resection and 8 had failed en-bloc resection. The importance of en-bloc resection in oncological control when compared to intralesional resection and failed en-bloc resection is underlined by the recurrence-free survival within the study period (90.9% v. 62.5% v. 77.8%) and overall survival (90.9% v. 61.1% v. 75%). As could be expected, surgical adverse events are, however, higher with planned extensive surgery (100% within a year) when compared to deliberate intralesional resection (38.9%) and failed en-bloc resection (75%). **Conclusion:** This multicentre case series analysis provides

critical insights into the clinical and patient-reported outcomes in the largest cohort of surgically treated cervical spine chordomas described to date and highlights the importance of wide resection for oncological control. It further establishes the associated morbidity related to the surgical strategies available.

E-65
Abstract ID 83

The effect of hemodynamic management and venous thromboembolism prophylaxis on intraparenchymal hemorrhage progression in a porcine model of traumatic spinal cord injury. ***Aysha Allard Brown,[1] Kitty So,[1] Neda Manouchehri,[1] Megan Webster,[1] Jay Ethridge,[1] Audrey Warner,[1] Avril Billingsley,[1] Rochelle Newsome,[1] Kirsten Bale,[1,2] Andrew Yung,[1,2] Mehara Seneviratne,[1] Jimmy Cheng,[1] Jing Wang,[1] Shenani Basnayake,[1] Femke Streijger,[1] Manraj Heran,[3] Piotr Kozlowski,[1,2] Brian K. Kwon.[1,4]*** **From the [1]International Collaboration on Repair Discoveries (ICORD), Vancouver, B.C.; the [2]University of British Columbia MRI Research, Vancouver, B.C.; the [3]Department of Radiology, Division of Neuroradiology, University of British Columbia, Vancouver, B.C.; the [4]Vancouver Spine Surgery Institute, Department of Orthopaedics, University of British Columbia, Vancouver, B.C.**

Background: Following acute traumatic spinal cord injury (SCI), the microvasculature of the spinal cord is often disrupted, resulting in bleeding within the tissue, known as intraparenchymal hemorrhage (IPH). Historically, the presence of IPH on magnetic resonance imaging (MRI) has been considered a reflection of a severe injury and associated with a poor prognosis. Hence, quantifying IPH within the injured cord is crucial to understanding how current treatment protocols for patients with acute SCI might influence IPH severity. Thus, the objective of this study was to determine to what extent mean arterial pressure (MAP) augmentation and venous thromboembolism (VTE) prophylaxis affect the extent of IPH after injury to inform the clinical management for patients with acute SCI. **Methods:** Thirty female Yucatan minipigs were randomly allocated into 5 groups (n = 6 per group): 1) T10 contusion–compression SCI only, 2) MAP augmentation, 3) early VTE prophylaxis, 4) MAP augmentation + early VTE prophylaxis and 5) MAP augmentation + late VTE prophylaxis. Norepinephrine was used to increase the MAP by 20 mm Hg for 3 hours daily over 7 days after SCI. Enoxaparin was administered every 12 hours for 7 days, starting at either 12 hours (early VTE) or 72 hours (late VTE) after SCI. High-frequency in vivo ultrasonography images were acquired before and hourly after SCI to track early hemorrhage progression. At the experimental end point (7 d after SCI), in vivo ultrasonography, ex vivo magnetic resonance imaging (MRI) and histology images were captured, and semi-automated pipelines were developed to measure IPH extent from these images. **Results:** Preliminary MRI findings revealed that the IPH volume (in cubic millimetres) at 7 days after SCI was greater in the MAP augmentation, early VTE and MAP augmentation + early VTE groups than in the SCI-only group. The statistical analysis is currently underway, and the finalized results will be presented during the conference. **Conclusion:** This study illustrates the power of using multiple imaging systems to investigate IPH progression following SCI, an approach that we hope will become more frequently adopted for translational SCI research.

ABSTRACTS FOR PRESENTATION — E-POSTER SECTION

P-100
Abstract ID 92

Economic comparisons of endoscopic spine surgery: a systematic review. ***Jeff D. Golan, Lior M. Elkaim, Qais Alrashidi, Miltiadis Georgiopoulos, Oliver J. Lasry.*** **From McGill University, Montréal, Que.**

Background: Full-endoscopic techniques are minimally invasive surgery (MIS) alternatives to traditional spinal surgery. We performed a systematic review of the literature to assess the costs of these techniques compared to more traditional approaches. **Methods:** A systematic review of the literature was performed for studies that compared costs from endoscopic decompressions of the lumbar spine for stenosis or disc herniation to those from open or microsurgical decompressions. The search was performed from Jan. 1, 2005, to Oct. 22, 2022, in the following databases: MEDLINE, Embase Classic, Embase and Cochrane Central. The included studies were each evaluated according to a formal assessment checklist to evaluate the quality of economic evaluations based on 35 criteria. **Results:** A total of 1153 studies were identified, with 9 articles included in the final analysis. The study with the fewest met criteria scored 9/35, and the study with the most met criteria scored 28/35. Only 3 studies provided incremental cost-effectiveness ratio estimates. Surgical times varied between studies, but hospital length of stays were consistently shorter with endoscopy. While endoscopy was more frequently associated with higher operating costs, studies that measured health care and societal costs showed endoscopy to be advantageous. **Conclusion:** Endoscopic spine surgery was found to be cost-effective in treating patients with lumbar stenosis and disc herniation when compared to standard microscopic approaches from a societal perspective. More well-designed economic evaluations investigating the cost-effectiveness of endoscopic spine procedures are needed to further support these findings.

P-101
Abstract ID 120

Prospective Prophylactic Antibiotics Regimen in Scheduled Spine Surgery — the PPARiSSS Cohort. An independently verified and validated cohort study of extended antibiotic prophylaxis combined with standardized tissue handling and perioperative wound care in 1000 scheduled lumbar pedicle-screw implant surgeries. ***Drew A. Bednar, Alyson Love, Soroush Nedaie, Pranjan Gandhi.*** **From McMaster University, Hamilton, Ont.**

Background: The objective was to present the independently verified and validated results of a standard protocol for prophylaxis of deep surgical site infection (SSI) in scheduled lumbar reconstructive surgery, as applied in a large prospective cohort.

Methods: Surgical logs of the senior author (D.A.B.) were reviewed for all cases of scheduled lumbar reconstruction with the goal of analyzing 1000 cases. Emergencies, fractures, tumours and surgery for a priori spine sepsis (i.e., discitis instability) were excluded. After preliminary office-based scan of the results, ethics board approval was obtained, and an independent team of 4 observers reviewed all available online hospital records of the subject cases. The largest cohort subgroup was analyzed for interrater consistency. **Results:** Only 5 deep SSIs requiring operative débridement were identified. This may represent a significant decrease against the 15 cases expected per best-available current meta-analysis on point. There were no secondary SSIs and no increase in expected antibiotic-resistant organism frequency in the population as followed forward. **Conclusion:** A consistent program of SSI prophylaxis was easily administered to a large cohort over an extended time frame even in Canada's under-resourced health care system. It has produced a rate of deep SSI much lower than the expected and, if applied consistently, has potential to significantly decrease the care cost and morbidity of this difficult problem.

P-102
Abstract ID 130

The impact of concurrent deformity on patient-reported outcomes following 1- to 3-level lumbar surgery not aimed at deformity correction. ***Prarthan C. Amin*,[1,2] *Aditya Raj*,[1,2] *Greg McIntosh*,[3] *Christopher J. Neilsen*,[1,2,3] *Ganesh Swamy*,[4,5] *Raja Rampersaud (On behalf of CSORN investigators)*,[1,2,3] *CSORN Spine Registry*.[3] From [1]Toronto Western Hospital/ University Health Network, Toronto, Ont.; the [2]University of Toronto, Toronto, Ont.; [3]Canadian Spine Society, Toronto, Ont.; [4]Canadian Spine Society, Calgary, Alta.; the [5]University of Calgary, Calgary, Alta.**

Background: The aim of this study was to compare patient reported outcomes (PROs) at 3 and 12 months after short-segment lumbar surgery (1–3 levels) for patients with and without spinal deformity. **Methods:** From the Canadian Spine Outcomes and Research Network (CSORN) registry there were 438 patients included who had degenerative diagnoses and underwent 1–3 levels of lumbar decompression alone or with fusion not aimed at overall lumbar/global realignment. All cases were prospectively categorized into 2 groups: no deformity (n = 311) or presence of lumbar deformity (n = 127), defined as sagittal (neutral or kyphosis) and/or coronal (< 10°, 10–20°, > 20°). Differences in 3- and 12-month PROs were compared overall, stratified by surgery type and for specific diagnosis. **Results:** There was no difference in the distribution of decompression alone/fusion between the deformity (52%/48%) and no-deformity (54%/46%) groups. Overall, the deformity group showed statistically significantly longer operative time (161 v. 135 min), length of hospital stay (3.3 v. 2.2 d) or adverse events (30% v. 19%) ($p < 0.05$). When adjusted for baseline differences in individual PRO scores and demographic differences (age, tobacco use and symptom duration), there were no statistically significant differences in PROs at 3 and 12 months by group. There was a trend for less improvement in EuroQol-5D (EQ-5D) score (Δ 0.23 v. 0.18) and 12-Item Short Form Survey (SF-12) Physical Component Summary score (Δ 12.4 v. 9.3) at 12 months in the deformity group. For patients with stenosis and spondylolisthesis, there was a significant difference in Oswestry Disability Index (ODI) score improvement for those in the no-deformity v. deformity group (Δ –21.6 v. –16.2, p = 0.05) at 12 months. When stratified by surgery type (decompression alone v. decompression and fusion), there were no significant differences in PROs at 3 months and 12 months between the 2 groups. Decompression alone for deformity had the worse ODI outcome at 12 months (Δ –20.7 v. –12.5, p = 0.16). **Conclusion:** Patients with concurrent deformity had worse perioperative outcomes with short-segment lumbar spinal surgery. There was no overall statistically significant difference in PROs at 3 and 12 months; however, trends in differential outcomes existed in subgroup analyses and require further exploration with a larger sample size.

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Abstract ID 136

Describing available preoperative education methods and comparing outcomes for spinal fusion candidates: a cross-Canada study. ***Amanda Vandewint*,[1,2] *Y. Raja Rampersaud*,[3,4,5,6] *Jeffrey Hebert*,[7,8] *Erin Bigney*,[2,9,10] *Neil Manson*,[1,2,9,11] *Najmedden Attabib*,[1,2,9] *Chris Small*,[1,2,9,11] *Eden Richardson*,[2,9,12] *Jill Kearney*,[2,9] *Edward Abraham*.[1,2,9,11] From [1]Dalhousie Medicine New Brunswick, Saint John, N.B.; the [2]Canada East Spine Centre, Saint John, N.B.; the [3]Schroeder Arthritis Institute, University Health Network, Toronto, Ont.; the [4]Krembil Research Institute, University Health Network, Toronto, Ont.; the [5]Division of Orthopedics, University Health Network, Toronto, Ont.; the [6]Department of Surgery, University of Toronto, Toronto, Ont.; the [7]Department of Kinesiology, University of New Brunswick, Fredericton, N.B.; [8]Murdoch University, Murdoch, Australia; the [9]Horizon Health Network, Saint John, N.B.; the [10]University of New Brunswick, Fredericton, N.B.; [11]Saint John Orthopaedics, Saint John, N.B.; the [12]Canadian Spine Outcomes and Research Network, Markdale, Ont.**

Background: The objectives were to 1) describe preoperative education practices among Canadian spine surgeons for patients undergoing spinal fusion and 2) investigate the effects of these recommendations on patient outcomes. **Methods:** We surveyed surgeons contributing to the Canadian Spine Outcomes and Research Network (CSORN) registry regarding their demographics, preoperative patient educational procedures and perceptions of education. Retrospective data were incorporated from CSORN patients who underwent thoracolumbar fusion with 3- and 12-month follow-up. Survey responses established patient cohorts with or without access to a preoperative multidisciplinary education class. Study outcomes comprised patient satisfaction, expectation fulfillment, resource utilization and length of stay (LOS). Propensity score models using inverse probability weights and regression adjustment accounted for confounding from age, sex, education, time with condition, principal pathology, baseline disability and mental health status. **Results:** We included data from 31 surgeons (64.5% orthopedic, 35.5% neurosurgeons) representing 16 centres and 448 patients (mean age 59.71 yr [standard deviation (SD) 11.86 yr], 58.5% female, class group n = 130). Surgeons favoured using spine models (71.0%) and pamphlets (61.3%) among listed education tools. A patient preoperative education class was available to 6.5% of surgeons, while 12.9%

selected none of the preoperative education opportunities. On an 11-point scale of preoperative education importance ranging from 0 (not important) to 10 (very important), the mean for surgeon responses was 8.90 (SD 1.30) points (range 5–10 points). No differences were seen between education groups (with v. without class access) for patient satisfaction and resource utilization at 3 or 12 months. The average LOS was 2.29 days shorter ($p = 0.017$) for the class group. The class group was more likely to achieve expectations for mental health (odds ratio [OR] 1.85, 95% confidence interval [CI] 1.12–3.06) and return to recreational activities (OR 2.07, 95% CI 1.24–3.45) at 12 months. Conversely, the class group showed decreased odds of meeting expectations for independence at 3 months (OR 0.51, 95% CI 0.31–0.83). **Conclusion:** Recommending a multidisciplinary education class before surgery may confer benefits for patient outcomes, yet utilization in Canada is very limited. Addressing this gap nationally represents an opportunity to improve quality of care.

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Abstract ID 144

Matched-cohort investigation comparing minimally invasive and traditional open lumbar decompression and interbody fusion: a Canadian Spine Outcomes and Research Network (CSORN) study. ***Raja Rampersaud,[1] Aditya Raj,[2] Nanadan Marathe,[2] Greg McIntosh,[3] the CSORN Investigators.[3]*** **From the [1]Schroeder Arthritis Institute, University Health Network, Toronto, Ont.; the [2]Toronto Western Hospital, University Health Network, Toronto, Ont.; the [3]Canadian Spine Society, Markdale, Ont.**

Background: There is limited evidence whether the reported benefits of minimally invasive spinal (MIS) fusion are greater in elderly or obese patients. The objective of this study was to investigate potential differences in clinical and patient-reported outcomes (PROs) when stratified by age and body mass index (BMI) among patients undergoing open versus MIS lumbar fusion. **Methods:** A retrospective review of Canadian Spine Outcomes and Research Network (CSORN) registry data. Surgical patients with degenerative lumbar disorders who underwent posterior decompression and interbody instrumented fusion (1 or 2 levels) were categorized into open (603) and MIS (318) groups. Assessments were done preoperatively, perioperatively, and at 3 months and 1 year follow-up. The analysis was stratified based on age < 65 and ≥ 65 years, and BMI < 30 and ≥ 30. **Results:** Significant ($p = 0.05$–0.001) perioperative differences were found between the MIS and open groups in operative time (180 min v. 195 min), estimated blood loss (182 cc v. 440 cc), length of stay (3.4 d v. 4.6 d), discharge home (98.1% v. 93.8%), blood products (1.3% v. 10%), intraoperative navigation (53.6% v. 26.2%) and use of bone graft substitutes (11.0% v. 19.9%). Overall, both groups revealed a similar degree of 3- and 12-month improvement in PROs when adjusted for the baseline scores. Patients aged ≥ 65 years demonstrated significant differences in intraoperative AEs (MIS 5% v. open 13%, $p < 0.05$). Open fusion demonstrated a difference in perioperative AEs based on age (≥ 65 32.4% v. < 65 21%, $p = 0.002$). Patients with BMI of ≥ 30 showed a trend toward better improvements in Oswestry Disability Index (ODI) score ($p = 0.09$), EuroQol-5D (EQ-5D) score ($p = 0.08$), and 12-Item Short Form Survey (SF-12) Physical Component Summary (PCS) score ($p = 0.08$) in the MIS group. There was also a higher chance of discharge to home (98.9% v. 91.2%) as compared to open in this group. **Conclusion:** Compared to open 1–2 level interbody fusion, use of an MIS technique did not differentially impact 3- and 12-month outcomes overall or stratified by age or BMI. However, patients with BMI ≥ 30 showed a trend toward better improvement in ODI, EQ-5D and SF-12 PCS scores in the MIS group. Patients aged ≥ 65 years experienced greater intra- and perioperative AEs with open fusion.

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Abstract ID 146

Measuring differences between interlamellar properties of the annulus fibrosus from degenerative disc disease and nondiseased young donor patients. ***Manmeet Dhiman, Taylor J. Bader, David Hart, Ganesh Swamy, Neil Duncan.*** **From the University of Calgary, Calgary, Alta.**

Background: Patients with degenerative disc disease (degen) exhibit severely degenerated annulus fibrosus (AF) at the time of surgery to alleviate pain and improve mobility. The lamellae that form the AF are interconnected through the interlamellar matrix (ILM), consisting of mainly collagen type VI, proteoglycans and elastin to help prevent delamination. Weakening of the ILM and less interlamellar cross bridges could contribute to delamination between the lamellae, reducing their ability to resist loads. The objective of this study was to quantify the differences in interlamellar mechanical properties from surgical and normal fresh tissue. **Methods:** Fresh human AF tissue was collected from 16 degen patients and 7 young non-degen organ donors. A peel test was performed in the circumferential direction to measure the interlamellar properties. The tissue underwent 20 cycles of preconditioning and 5-minute stress–relaxation, and was subsequently peeled at 0.5 mm/s until complete separation. **Results:** Non-degen and degen samples had a mean peel stiffness (± standard deviation [SD]) of 0.27 (± 0.07) N/mm^2 and 0.19 (± 0.08) N/mm^2, respectively ($p < 0.01$). Mean peel strength for the non-degen and degen samples was 2.39 (± 0.93) N/mm and 1.61 (± 0.76) N/mm, respectively ($p < 0.01$). The mean peel toughness of non-degen samples was 34.34 (± 15.04) J/m^3, whereas it was 22.59 (± 13.64) J/m^3 for degen samples ($p < 0.05$). No statistically significant differences were observed in peel region length and SD of the peel stress. **Conclusion:** Increased peel stiffness and peel toughness for non-degen samples showed that greater force and energy were required to peel the lamellae apart. The increased peel strength indicated greater adhesion between the lamellae for the non-degen samples than for the degen samples. Increasing trends were observed for non-degen samples for peel region length and SD of the peel stress. This study provided quantitative evidence that the mechanical integrity of ILM may be decreased in surgical patients with the degen condition compared to the non-degen patients.

P-106
Abstract ID 147

Assessing collagen damage in annulus fibrosus from patients with degenerative disc disease using a collagen hybridizing peptide. ***Manmeet Dhiman, Taylor J. Bader, Dragana Ponjevic, John R. Matyas, David Hart, Ganesh Swamy, Neil Duncan.*** **From the University of Calgary, Calgary, Alta.**

Background: Intervertebral discs (IVDs) from patients with degenerative disc disease (degen) exhibit severely degenerated annulus fibrosus (AF) at the time of surgery performed to alleviate pain and improve mobility. Extracellular matrix (ECM) degradation of the AF has been correlated with degeneration of the IVD. Collagen is a vital component of the ECM of the IVD. Collagen hybridizing peptide (CHP) is an engineered protein that can quantify and monitor the collagen damage by binding to the degraded collagen directly. The objective of this study was to assess the mean fluorescence intensity and percent positive region of interest (ROI) with CHP from surgical and non-degen fresh AF tissue samples. **Methods:** Fresh human AF tissue was collected from 13 degen patients and 6 young non-degen organ donors. Tissue was sectioned at 6-µm thickness, and hematoxylin and eosin (H&E) staining was performed for morphologic assessment. CHP solution with Cy3 was directly applied to the sections. Three ROIs were selected as representative of the sections. **Results:** Surgical samples stained with H&E exhibited qualitative morphological structure changes with tissue organization. DAPI staining showed increased cellularity in the ROI for degen samples. Non-degen and degen samples had an average mean (± standard deviation) fluorescence intensity of 6301 (± 1653) and 10 103 (± 3370), respectively ($p < 0.001$). Non-degen and degen samples had an average percent positive ROI area of 18.8% (± 11.0%) and 46.5% (± 18.9%), respectively ($p < 0.001$). **Conclusion:** Qualitative differences observed through H&E and DAPI staining showed that there are structural changes at the tissue level, which may develop from more collagen damage observed using CHP at the molecular level. Quantification of collagen damage through increased mean fluorescence intensity and percentage positive ROI area showed increased concentration and spatial variation of collagen damage in degen samples compared to non-degen samples. This study provides quantitative evidence that the structural integrity of collagen may be decreased in surgical patients with the degen condition compared to non-degen patients.

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Abstract ID 150

The effects of using antidepressants for presurgical pain management on postsurgical pain and disability outcomes in patients with lumbar spinal stenosis. ***Connor P. O'Brien,[1,2] Jeffrey Hebert,[3] Erin Bigney,[2,3,4] Jillian Kearney,[2,4] Eden Richardson,[2,4] Edward Abraham,[2,4,5] Neil Manson,[2,4,5] Najmedden Attabib,[2,4,5] Christopher Small.[1,2,4,5]*** **From [1]Memorial University of Newfoundland, St. John's, N.L.; the [2]Canada East Spine Centre, Saint John, N.B.; the [3]University of New Brunswick, Fredericton, N.B.; the [4]Horizon Health Network, Saint John, N.B.; [5]Dalhousie University Saint John, Saint John, N.B.**

Background: The objective was to estimate the effects of presurgical antidepressant use for pain management on postsurgical pain and disability outcomes in patients with lumbar spinal stenosis (LSS). The secondary objective was to investigate the moderating role of preoperative depression risk. **Methods:** This was a retrospective cohort study utilizing data from patients with LSS enrolled in the Canadian Spine Outcomes and Research Network (CSORN) database. Baseline data included demographic, clinical and psychosocial variables, and analgesic antidepressant use. Depression risk status was assessed using the Patient Health Questionnaire module 8 (PHQ-8) (score ≥ 10 = depression risk). Outcomes included longitudinal scoring of back and leg pain (Numeric Rating Scale-B [NRS-B] and NRS-L) and disability (Oswestry Disability Index [ODI]). Patients were categorized as meeting minimal clinically important change (MCIC) and clinical success (CS), respectively, for ODI (29.2%, 43.7%), NRS-B (25.0%, 57.1%) and NRS-L (25.0%, 60.0%) at 3 and 12 months after surgery. We constructed propensity score models with inverse-probability weights and regression adjustment to control for confounding due to baseline disability, age, sex, education, smoking, previous surgery, regular exercise, fusion surgery, condition duration, and preoperative narcotic and neuroleptic medications. **Results:** We included data from 3435 patients (38.1% female; mean age 65.5 yr [standard deviation 11.3 yr]). In the total cohort, patients taking antidepressants reported greater disability (2.08, 95% confidence interval [CI] 0.20–3.97) and back pain (0.28, 95% CI 0.01–0.55) at 12 months, resulting in a reduced risk of achieving CS for back pain (relative risk [RR] 0.87, 95% CI 0.77–1.00). In the depression-risk cohort, those taking antidepressants reported higher 12-month disability (3.28, 95% CI 0.41–6.14) and back pain (0.42, 95% CI 0.02–0.82) scores; these patients had a reduced risk of achieving MCIC for disability (RR 0.86, 95% CI 0.74–0.99) and back pain (RR 0.85, 95% CI 0.74 to 0.97), and CS for disability (RR 0.77, 95% CI 0.62–0.95). Antidepressants had no effect on the low-depression–risk cohort. **Conclusion:** Preoperative antidepressant use had small adverse effects on long-term disability and back pain following LSS surgery. Preoperative depression appears to moderate these effects. Further investigation is warranted to assess the impact of antidepressant type, dosage and duration of use.

P-108
Abstract ID 163

Pseudarthrosis of the lumbar spine: a systematic review. ***Luke LaRochelle, Gabriella Rivas, James Lawrence, Robert Ravinsky.*** **From Medical University of South Carolina, Charleston, S.C.**

Background: Failure of solid bony fusion, known as pseudarthrosis, is a well-known complication of lumbar fusion with a potential to cause significant patient morbidity. Rates of pseudarthrosis following lumbar fusion procedures in the literature range from 5% to 35%. The purpose of this review was to evaluate and summarize the results of studies comparing different surgical techniques in the management of pseudarthrosis following failed lumbar fusion for nontraumatic etiologies. **Methods:** A literature search was conducted for articles that directly compared outcomes between surgical approaches for pseudarthrosis in the lumbar spine and had 10 or more patients in each study arm. **Results:** Four studies satisfied inclusion criteria and were included in the final review. Outcome measures varied between studies. None of the studies included showed a statistically significant difference in clinical or functional outcomes between groups. One retrospective study comparing instrumented posterolateral fusion (PSF), PSF with transforaminal lumbar interbody fusion (TLIF), anterior and posterior fusion (APF), and anterior lumbar interbody fusion (ALIF) showed that the TLIF group had greater blood loss during surgery (771 mL) and a longer operative time (327 min). ALIF had the lowest blood loss

(272 mL) and shortest operative time (178 min). The APF group had a longer average hospital stay than the other groups (6.29 d). In another study comparing anterior–posterior revision (APR) and posterior instrumentation and fusion, the APR group had increased radiographic fusion rates at 1 year follow-up (79% v. 37%) but had more perioperative complications. **Conclusion:** To date, no study comparing surgical approaches for pseudarthrosis revision surgery in the lumbar spine has demonstrated superiority of a particular approach in achieving clinical or functional improvement. There is some evidence that certain approaches may increase perioperative morbidity and the risk of perioperative complications, but more research is needed to better characterize the risks and advantages of each surgical approach in lumbar revision surgery.

P-109
Abstract ID 8

What is the diagnostic accuracy of community spine x-rays for adolescent idiopathic scoliosis brace candidates? ***Dorothy Kim,[1] Jennifer Dermott,[1] Aya Mitani,[2] Andrea Doria,[1] Andrew Howard,[1] David Lebel.[1]*** **From the [1]Hospital for Sick Children, Toronto, Ont.; the [2]University of Toronto, Toronto, Ont.**

Background: Only a small proportion of patients with adolescent idiopathic scoliosis (AIS) are brace candidates on initial visit, thereby increasing surgical burden. While AIS detection occurs in the community, community spine x-rays can be of inadequate quality. This study aimed to establish the diagnostic accuracy of community spine x-rays for brace candidates. **Methods:** A review of patients with AIS seen for initial visit at a tertiary care pediatric hospital between January and September 2021 was conducted, excluding those with missing index Cobb angle, index imaging from the same institution or second opinions (n = 170). The index test was the pre-referral community spine x-ray evaluated by community radiologist. The diagnostic criterion for brace candidates was dichotomized by Cobb angle (25°–40°) as per the Scoliosis Research Society. Risser stage was excluded given missing index data (n = 110). Measures of diagnostic accuracy for the index test were determined against the reference standard if images were obtained within 90 days (n = 111). The reference standard was the 3-foot standing EOS x-ray obtained on initial visit, evaluated by orthopedic spine specialists. Sensitivity analyses were conducted on a subsample of data with index test within 60 days (n = 67). Late referrals were those who presented as likely surgical candidates. **Results:** The study cohort was mostly female (76.6%), with an average age of 13.7 years. The accuracy of the community spine x-ray to detect a brace candidate was 65.8% (95% confidence interval [CI] 56.2–74.5). Sensitivity of the index test was 65.4%, with a false-negative rate of 34.6%. Specificity was 66.1%, with a false-positive rate of 33.9%. Positive and negative predictive values were 63.0% and 68.4%, respectively. Positive likelihood ratio was 1.99. Of the total number of true brace candidates (n = 52), 32.7% (95% CI 21.5–46.2) were missed due to underestimation. With index images within 60 days of reference standard, accuracy remained 67.2% (95% CI 54.6–78.1). The proportion of missed brace candidates due to underestimation was unchanged with 60-day data (p = 0.37). The proportion of late referrals was 34.2%. **Conclusion:** Inaccuracies in community spine radiology may contribute to missed opportunities for conservative treatment.

P-110
Abstract ID 14

A comparative study of protocols for spinal casting in severe early-onset scoliosis: a 4-year progression-free survival analysis. ***Jennifer A. Dermott, Lily S. Switzer, Dorothy J. Kim, David E Lebel.*** **From the Hospital for Sick Children, Toronto, Ont.**

Background: The objective was to compare the outcomes of an intermittent versus continuous spinal casting protocol in severe early-onset scoliosis (EOS), focusing on progression-free survival time. **Methods:** This was a retrospective review of all 43 patients with EOS managed with spinal casting at a single institution with at least 2 cast applications (intermittent) or over 12 months of casting (continuous), initiated between November 2002 and April 2022. Kaplan–Meier methods estimated the probability of progression-free survival at 4 years, defined as time to curve progression beyond index or a surgical decision, whichever occurred first. Cox proportional hazards model considered association between progression-free survival and cast protocol, sex, etiology, age at first cast, index Cobb angle and percent correction achieved in first cast. **Results:** Thirty patients underwent intermittent casting (24 female, 14 idiopathic), and 13 underwent continuous casting (7 female, 5 idiopathic). At baseline, the 2 groups were similar in sex (p = 0.17), etiology (p = 0.87), and Cobb angle (63.5° v. 69.1°, p = 0.26) but differed in age (3.85 yr v. 2.7 yr, p < 0.05). Correction achieved in first cast was similar (48.7% v. 44.4%, p = 0.09) but continued to improve only for continuous cast patients (–10.6° v. 7.2°, p < 0.001). At 4 years, 20 patients (46.5%) showed progression beyond index (n = 13 [65%]) or had a definitive surgical plan (n = 7 [45%]). Survival time was not associated with cast protocol (p = 0.4), as the adjusted survival probability at 4 years was similar (intermittent 0.462 v. continuous 0.559, p = 0.53). Idiopathic patients had a higher survival probability (0.668 v. 0.334, p < 0.05) as did in-cast correction above the median 47% (0.653 v. 0.319, p < 0.05). Nonidiopathic etiology was associated with decreased survival (adjusted hazards ratio [HR] 4.05, p < 0.05) and more flexible curves with improved survival (adjusted HR 0.93, p < 0.05). **Conclusion:** Nonidiopathic etiology and curve stiffness, not cast protocol, decreased the probability of 4-year progression-free survival for severe EOS patients treated with spinal casting. A continuous cast protocol allows for ongoing improvement of in-cast Cobb angle; however, it did not demonstrate an out-of-cast advantage in the short term. Both protocols effectively delayed surgery in severe EOS.

P-111
Abstract ID 36

Aquatic therapy for chronic low back pain: preliminary insights into muscle strength and psychological outcomes. ***Chanelle Montpetit,[1] Nicolas Vaillancourt,[1] Brent Rosenstein,[1] Maryse Fortin.[1,2,3]*** **From [1]Concordia University, Montréal, Que.; the [2]School of Health, Concordia University, Montréal, Que.; the [3]Centre de Recherche Interdisciplinaire en Réadaptation, Montréal, Que.**

Background: Low back pain (LBP) is the leading cause of years lived with disability worldwide. Chronic LBP is associated with impaired paraspinal and gluteal muscle function and morphology. Despite exercise therapy being recommended as a first-line conservative treatment for chronic LBP, many individuals harbour fear-avoidance beliefs that hinder their physical activity. Aquatic therapy (AT) reduces spinal loading, thereby increasing movement capacity and facilitating exercises that may be challenging on land. To our knowledge, no studies have examined the effects of AT on paraspinal/gluteal strength and psychological outcomes. The study aimed to investigate the effects of an AT exercise intervention versus standard care (SC) on 1) paraspinal and gluteal strength, and 2) patient-oriented outcomes (pain, disability and psychological factors). **Methods:** This pilot study is part of a larger ongoing randomized controlled trial; preliminary results are presented. Seventeen participants aged 18–65 with moderate to severe nonspecific chronic LBP were randomized to the AT group (n = 10) or SC group (n = 7). Both groups completed a 10-week, twice-weekly supervised intervention. Baseline and postintervention assessment included lumbar extension and gluteal strength tests (Medex and hand-held dynamometer) and self-reported questionnaires. Two-way repeated-measures analysis of variance was used to assess changes in muscle and psychological outcomes within and between groups. **Results:** There was a significant increase in gluteus medius strength across time points in the AT group (mean difference [MD] 125.97, $p < 0.001$) compared to the SC group (MD 54.00, $p = 0.06$). Both groups significantly increased lumbar extensor strength (AT: MD 47.0, $p < 0.001$; SC: MD 30.00, $p = 0.02$) and gluteus maximus strength (AT: MD 55.57, $p = 0.005$; SC: MD 52.19, $p = 0.02$) across time points. The AT group saw a significant decrease in pain (MD 2.78, $p < 0.001$), disability (MD –18.0, $p < 0.001$), pain catastrophizing (MD –7.0, $p = 0.006$) and kinesiophobia (MD –4.88, $p = 0.03$). The SC group saw a significant decrease in pain (MD –3.14, $p < 0.001$), disability (MD –14.57, $p < 0.001$) and pain catastrophizing (MD –9.14, $p = 0.002$), with no difference across groups for all self-reported outcomes. **Conclusion:** The AT group demonstrated a significant increase in strength and patient-oriented outcomes, highlighting its potential for improving musculoskeletal health and well-being in individuals with chronic LBP.

P-112
Abstract ID 51

The true cost of late referral in adolescent idiopathic scoliosis: a 5-year follow-up and cost analysis study. ***Emma Nadler, Jennifer Dermott, Dorothy Kim, David E. Lebel.*** **From the Hospital for Sick Children, Toronto, Ont.**

Background: The objective was to analyze the total treatment cost differential between patients with adolescent idiopathic scoliosis (AIS) who, at initial consultation, are ideal brace candidates versus late referrals. **Methods:** This was a retrospective review and cost analysis of patients with AIS seen for initial consultation in 2014. Late referrals and ideal brace candidates were identified. Late referrals were defined as ≥ 50° curvatures, or over 40° and Risser stage 2 or less. Ideal brace candidates were defined as 25°–40°, Risser stage 2 or less. Electronic patient charts were reviewed to determine progression in brace candidates to surgical range, up to 5 years after initial visit. Costs assumed patients with ≥ 50° curvatures would at some point have surgery. In addition to the cost of a brace or a surgical procedure, total treatment costs considered typical number of clinic visits (including associated travel, parking, meals and loss of income costs for family) and spine x-rays obtained. **Results:** Of the 370 new patients with AIS seen in 2014, 63 (17%) met ideal brace indications, compared to 103 patients (28%) considered late referral. The average total cost per patient for brace treatment was calculated at $13 459, versus $68 009 for surgical treatment. Within the 5-year study period, 10 ideal brace candidates progressed to ≥ 50° curvatures, and 5 were lost to follow-up. Assuming that all 15 (24%) of these patients went on to surgery, the total cost for this group would theoretically be $1.87 million, versus $7.00 million for late referrals. If all late referrals had instead been ideal brace candidates, the total cost of treatment, including surgical costs for patients expected to progress despite brace treatment, would be $4.95 million, a cost savings of $3.92 million. **Conclusion:** These findings underscore the financial consequences of late AIS diagnosis, emphasizing the need for early detection to reduce the cost burden.

P-113
Abstract ID 52

The effect of transcutaneous electrotherapies on self-reported outcomes in patients with chronic low back pain: a systematic review and meta-analysis. ***Daniel Wolfe, Brent Rosenstein, Maryse Fortin.*** **From Concordia University, Montréal, Que.**

Background: Chronic low back pain (CLBP) is the leading cause of years lived with disability worldwide. Transcutaneous electrotherapies have been widely used to treat CLBP, but, with the partial exception of transcutaneous electrical nerve stimulation (TENS), their effect on pain, disability, quality of life and psychosocial outcomes have not been systematically reviewed. The purpose of this systematic review and meta-analysis was to clarify the overall effect of transcutaneous electrotherapies on self-reported outcomes in patients with CLBP. **Methods:** Four databases and 2 study registries were searched for studies that utilized transcutaneous electrotherapies as a primary intervention for CLBP, compared against active or passive controls. Two reviewers independently extracted study data and assessed risk of bias. Studies were grouped by intervention versus comparison and by time of follow-up. Meta-analyses were conducted where appropriate. **Results:** A total of 89 full-text studies were assessed for eligibility; 14 studies were included, with 6 in the meta-analyses (all TENS or mixed TENS). Regarding pain, meta-analyses revealed no significant difference for TENS versus active control, TENS versus passive control, or mixed TENS versus active control after intervention, or for mixed TENS versus active control at 1 month after intervention. Interferential current (IFC) was more effective than active control (2 studies), while electromyostimulation (EMS) was generally superior to passive, but not active, controls (6 studies). Regarding disability, meta-analyses revealed no significant difference for TENS versus active control after intervention, mixed TENS versus active control after intervention, or mixed TENS versus active control at 1 month after intervention. We were unable to perform meta-analyses for quality of life or psychosocial outcomes. **Conclusion:** There is moderate evidence that TENS is similar to all controls for improving pain and disability. There is limited evidence that IFC is superior to active controls for improving pain and disability. There is limited evidence that EMS

is superior to passive but not active controls for improving pain, and similar to all controls for improving disability.

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Abstract ID 84

The immediate effect of a single treatment of neuromuscular electrical stimulation with the StimaWELL 120MTRS system on multifidus stiffness in patients with chronic low back pain. ***Daniel Wolfe,[1] Geoffrey Dover,[1] Mathieu Boily,[2] Maryse Fortin.[1]*** **From [1]Concordia University, Montréal, Que.; the [2]McGill University Health Centre, Montréal, Que.**

Background: Individuals with chronic low back pain (CLBP) have greater difficulty activating the lumbar multifidus muscle than healthy controls. Neuromuscular electrical stimulation (NMES) was previously reported to elicit multifidus activation in patients with LBP, but its immediate effect on resting multifidus muscle stiffness has never been investigated. The aim of this study was to examine the effect of a single treatment with the StimaWELL 120MTRS system (a medium-frequency electrotherapy device) on prone resting lumbar multifidus stiffness. We hypothesized that a single NMES treatment would facilitate neural drive to the multifidus and lead to an acute/temporary increase in prone resting multifidus stiffness at L4 and L5. **Methods:** Twenty-eight participants (16 women, 12 men, mean age 42.9 yr [standard deviation 12.6 yr]) with CLBP were recruited from a broader randomized controlled trial examining the effect of a 10-week intervention with the StimaWELL 120MTRS system on multifidus morphology and function. During participants' third visit, shear-wave elastography measurements of the multifidus in prone at L4 and L5 were taken prior to and 15 minutes after a 20-minute NMES treatment. Three images were acquired per side, per level, and the average stiffness was calculated. Paired *t* tests and Wilcoxon signed rank tests were used to compare the change in resting stiffness from before to after treatment. **Results:** Wilcoxon signed rank tests revealed a significant increase in multifidus stiffness on the right (mean difference [MD] ± standard deviation 1.79 kPa ± 7.47 kPa, $p = 0.033$) and left side (MD 2.27 kPa ± 6.25 kPa, $p = 0.035$) at the L5 level. Paired *t* tests revealed no significant changes in stiffness at the L4 level on the right (MD 1.89 kPa ± 5.78 kPa, $p = 0.094$) or left side (MD 0.83 kPa ± 7.93 kPa, $p = 0.588$). **Conclusion:** This study provides preliminary evidence that a single NMES treatment with the StimaWELL 120MTRS system acutely increases lumbar multifidus stiffness at L5 in patients with CLBP. NMES treatment with the StimaWELL 120MTRS may have a priming effect on the lumbar multifidus at L5. We plan to continue our investigation to expand our findings.

P-115
Abstract ID 23

Contemporary trends in the incidence and timing of spinal metastases: a population-based retrospective cohort study. ***Husain Shakil,[1] Armaan K. Malhotra,[1] Jetan H. Badhiwala,[1] Vishu Karthikeyan,[1] Yingshi He,[1] Michael G. Fehlings,[1] Arjun Sahgal,[1] Nicolas Dea,[2] Alex Kiss,[1] Christopher D. Witiw,[1] Donald R. Redelmeier,[1] Jefferson R. Wilson.[1]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]University of British Columbia, Vancouver, B.C.**

Background: Understanding the epidemiology of spinal metastases is vital for health care policy optimization and patient counselling. In this study, we assessed recent trends in the incidence and timing of spinal metastases. **Methods:** We conducted a retrospective analysis of population-based health data from 2007 to 2019 in Ontario, Canada. Outcomes measured included annual incidence rate of spinal metastases, time to metastases after primary diagnosis, and 3-year incidence rate of spinal metastasis after primary diagnosis. **Results:** We identified a cohort of 37 375 patients with spine metastases. The most common primary sites of cancers were lung, breast, prostate, gastrointestinal, myeloma and urological. The age-standardized incidence of spinal metastases increased from 229 to 302 cases per million persons over the 13-year study period. The average annual percent change (AAPC) in incidence was 2.2% (95% confidence interval [CI] 1.4%–3.0%), with patients aged ≥ 85 years demonstrating the largest increase (AAPC 5.2%, 95% CI 2.3%–8.3%). Lung cancer had the greatest annual incidence, while prostate cancer had the greatest increase in annual incidence (AAPC 6.5, 95% CI 4.1%–9.0%). Patients with lung cancer were found to have the highest risk of a spine metastasis, with 16.5% (95% CI 16.1%–16.8%) of patients being diagnosed at 5 years and 18.7% (95% CI 18.2%–19.2%) at 10 years. Patients with gastrointestinal cancer were found to have the lowest risk of a spine metastasis, with 2.8% (95% CI 2.7%–2.9%) of patients being diagnosed at 5 years and 3.9% (95% CI 3.7%–4.1%) at 10 years. **Conclusion:** The incidence of spinal metastases increased in recent years, particularly among older patients. Furthermore, the incidence and timing of metastasis varied substantially among different primary cancer types. These findings contribute to the understanding of disease trends and emphasize a growing population of patients who require subspecialty care.

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Abstract ID 39

Automated psoas muscle segmentation: radiomic features and surgical fitness in spinal metastatic lung cancer. ***Marco Pérez Caceres,[1] Véronique Freire,[2] Jesse Shen,[2] Fidaa Al-Shakfa,[2] Omer Ahmed,[1] Zhi Wang.[2]*** **From the [1]Université de Montréal, Montréal, Que.; the [2]Centre hospitalier de l'Université de Montréal, Montréal, Que.**

Background: Lung cancer propensity for spinal metastasis leads to fractures, dysfunction, pain and reduced quality of life. Properly selected fit patients benefit from surgical intervention. Sarcopenia as depicted by psoas muscle measurements has been proposed as an imaging marker predicting postoperative survival/surgical fitness, with no consensus measurement. By developing an automated deep-learning model to take robust, standardized and scalable measurements, we explore/validate radiomic marker and estimate their predictive capacity. **Methods:** A retrospective cohort study of 63 patients (mean age 64 yr, standard deviation 9 yr; 46% female) with spinal metastatic lung cancer having undergone surgery at the Centre hospitalier de l'Université de Montréal between 2010 and 2020 was undertaken. Abdominal and spinal computed tomography scans with varied field of views (FoVs) were used. Manual psoas muscle and lumbar vertebrae segmentation was validated with an experienced musculoskeletal radiologist. Image pre- and postprocessing was performed with

advanced normalization tools and in-house scripts. An active learning strategy was employed with 15 test cases. Varied model architectures were trained using the nnU-Net framework for psoas and vertebrae segmentation tasks. A total of 120 radiomic features normalized to patient height were derived; sarcopenia was determined with sex-specific unsupervised models (k-means, gaussian mixture) and published values. **Results:** Five-fold cross-validation 3D full-resolution models performed best for psoas and vertebral segmentation, with Dice and Jaccard scores of 0.92/0.89 and 0.94/0.89, respectively. Performance was consistent between acquisition types, noise levels and varied FoVs; rendering remained accurate in pathologic and postsurgical anatomy. Significant sex differences were shown in 86 features ($p < 0.01$), 70 after Bonferroni correction. Steeper Kaplan–Meier curve survival decline was shown for this cohort using values of Yuhei et al. ($p = 0.030$) and average area centred at L3 ($p = 0.031$), L4 ($p = 0.021$) and L5 ($p = 0.012$). **Conclusion:** These findings are consistent with the published literature and highlight the importance of sex-specific standardized features for reliable surgical fitness estimation. The automated models created offer a promising approach to standardization and should be further validated with larger and multicentre data sets. Integrating patient-specific features should yield more accurate predictions.

P-117
Abstract ID 76

What is the optimal management of patients with metastatic spine disease with intermediate spinal instability neoplastic scores: To operate or not to operate? ***William Chu Kwan,[1] Scott L. Zuckerman,[2] Charles G. Fisher,[1] Ilya Laufer,[3] Dean Chou,[4] John E. O'Toole,[5] Markus Schultheiss,[6] Michael H. Weber,[7] Daniel M. Sciubba,[8] Markian Pahuta,[9] John H. Shin,[10] Michael G. Fehlings,[11] Anne Versteeg,[12] Matthew L. Goodwin,[13] Stefano Boriani,[14] Chetan Bettegowda,[15] Aron Lazary,[16] Alessandro Gasbarrini,[14] Jeremy J. Reynolds,[17] Jorrit-Jan Verlaan,[18] Arjun Sahgal,[19] Ziya L. Gokaslan,[20] Laurence D. Rhines,[21] Nicolas Dea.[1]*** **From the [1]Combined Neurosurgical and Orthopaedic Spine Program, Department of Orthopaedic Surgery, University of British Columbia, Vancouver, B.C.; the [2]Department of Neurological Surgery, Vanderbilt University Medical Center, Nashville, Tenn.; the [3]Department of Neurological Surgery, New York University Grossman School of Medicine, New York, N.Y.; the [4]Neurological Institute of New York, Columbia University Irving Medical Center, New York, N.Y.; the [5]Department of Neurological Surgery, Rush University Medical Center, Chicago, Ill.; the [6]University of Ulm, Ulm, Germany; the [7]Spine Surgery Program, Department of Surgery, Montréal General Hospital, McGill University Health Centre, Montréal, Que.; the [8]Department of Neurosurgery, Zucker School of Medicine at Hofstra, Long Island Jewish Medical Center and North Shore University Hospital, Northwell Health, Manhasset, N.Y.; the [9]Department of Surgery, McMaster University, Hamilton, Ont.; the [10]Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, Mass.; the [11]Division of Neurosurgery and Spine Program, Department of Surgery, University Health Network, University of Toronto, Toronto, Ont.; the [12]Division of Orthopaedic Surgery, Temerty Faculty of Medicine, University of Toronto, Toronto, Ont.; the [13]Department of Orthopaedic Surgery, Washington University, St. Louis, Mo.; [14]Spine Surgery, IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy; the [15]Department of Neurosurgery, Johns Hopkins University School of Medicine, Baltimore, Md.; the [16]National Center for Spinal Disorders, Budapest, Hungary; the [17]Oxford Spinal Surgery Unit, Oxford University Hospitals, Oxford, United Kingdom; the [18]Department of Orthopaedic Surgery, University Medical Center Utrecht, Utrecht University, Utrecht, Netherlands; the [19]Department of Radiation Oncology, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont.; the [20]Department of Neurosurgery, Warren Alpert Medical School of Brown University, Providence, R.I.; the [21]Division of Surgery, Department of Neurosurgery, the University of Texas MD Anderson Cancer Center, University of Texas, Houston, Tex.**

Background: In patients with extradural metastatic spine disease, management of patients with intermediate Spinal Instability Neoplastic Score (SINS) lesions category is uncertain and remains controversial among clinicians. We sought to systematically review the outcomes and complications of 4 different treatment approaches: 1) radiotherapy, 2) percutaneous interventions, 3) minimally invasive surgeries (MISs) and 4) open spinal surgeries. **Methods:** Following PRISMA guidelines, we queried MEDLINE, Embase, Web of Science and Cochrane databases for studies that reported on patients with SINS intermediate score who underwent 1 of the above-mentioned treatments. Dates of publication were between 2013 and 2022. Patients with low- or high-grade SINS were excluded. Outcome measures were pain score, functional status, neurological outcome, ambulation, survival and perioperative complications. **Results:** Thirty-nine studies (pooled population = 4554) were included that analyzed outcomes in the SINS intermediate cohort. Radiotherapy (1205 patients in 12 studies) appeared to provide temporary improvement in pain score for up to 1 year. However, new or progressive pathologic fracture and recurrent pain led to surgery in 15%–20% of patients. We found limited evidence on percutaneous interventions (197 patients in 3 studies) including radiofrequency ablation and kyphoplasty, although they could provide improvement in pain with fewer complications. MIS (333 patients in 8 studies) and open surgery (472 patients in 9 studies) offered improvement in pain, quality of life, neurological function and survival. Ambulatory status was not significantly improved with MIS but improved with open surgery. Pooled data showed more complications with open surgery (massive bleeding, wound dehiscence, infection, hematoma). Some studies have suggested dividing SINS intermediate into lower scores not requiring stabilization, while patients with higher scores would benefit from spinal stabilization. **Conclusion:** Different treatment options are available for the heterogeneous presentation of SINS intermediate spinal bone metastases. Surgery should not be recommended for every patient but should be considered when mechanical pain is present. SINS on its own was not designed to determine the need for surgery. Understanding which other clinical and radiological factors associated with failure of nonoperative management is an important knowledge gap.

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Abstract ID 80

Does the number of spinal metastases affect the survival of patients with lung cancer? ***Van Tri Truong,[1,2] The Khanh Dang,[3] Galil Osman,[1] Fidaa Al-Shakfa,[1] Danielle Boule,[1] Jesse Shen,[4] Zhi Wang.[4]*** **From the [1]Research Centre, Centre Hospitalier de l'Université de Montréal, Université de Montréal, Montréal, Que.; the [2]Department of Neurosurgery, Vinmec Central Park International Hospital, Vinmec Healthcare System, Ho Chi Minh, Vietnam; the [3]Hue University of Medicine and Pharmacy, Hue, Vietnam; the [4]Division of Orthopaedics, Centre Hospitalier de l'Université de Montréal, Université de Montréal, Montréal, Que.**

Background: Lung cancer is one of the most common malignancies. Around 40% of patients with lung cancer develop bone metastases, with the vertebral column being the most frequently involved site. The prognostic factors for the survival of patients with lung cancer with spinal metastasis have been reported, but few studies have been done on the association between their survival and the number of metastatic vertebrae. Our study aimed to examine if the number of spinal metastases significantly influenced the survival of patients with lung cancer. **Methods:** A retrospective study of patients with lung cancer with spinal metastasis was performed. The variables, including age, gender, smoking history, tumour histology, region of spinal metastasis, number of spinal metastases, visceral metastasis, ambulatory status, postoperative adjuvant therapy, hemoglobin concentration, platelet count, albumin level and survival were collected. Data were analyzed to identify the factors significantly affecting survival. **Results:** A total of 234 patients treated in our centre from January 2008 to September 2023, including 11 with cervical spine metastasis, 78 with thoracic spine metastasis, 16 with lumbar spine metastasis, 4 with sacrum metastasis and 125 with metastases located at multiple spinal regions (combined group) were recruited. The mean age was 64 years. The median overall survival was 3.8 months (95% confidence interval [CI] 3.13–4.63). The survival of the cervical spinal, thoracic, lumbar, sacral and combined spinal metastasis groups was 6.17 months (95% CI 1.4–15.9), 3.7 months (95% CI 2.57–6.1), 2.53 months (95% CI 0.70–7.67), 10.7 months (95 CI 3.83–NA) and 3.7 months (95% CI 2.83–4.47), respectively ($p > 0.05$). The median survival of patients with 1 spinal metastasis, 2 spinal metastases, 3–9 spinal metastases and more than 10 spinal metastases was 8.37 months (95% CI 2.57–11.53), 4.1 months (95% CI 2.9–6.33), 3.27 months (95% CI 2.67–4.0) and 2.7 months (95% CI 1.2–10.7), respectively ($p > 0.05$). Independent walking ability, good Eastern Cooperative Oncology Group (ECOG) status, good Karnofsky Performance Scale score, albumin level above 35 g/L and targeted therapy were found to significantly affect survival ($p < 0.05$). **Conclusion:** The survival of patients with lung cancer with spinal metastasis was not influenced by the number of spinal metastases.

P-119
Abstract ID 110

Which patients have the best chances of improving their neurological status after pathologic spine fractures presenting with neurologic compromise? ***Maroun Rizkallah,[1,2,3] Ghassan Boubez,[4] Jesse Shen,[4] Philippe Phan,[5] Fidaa Alshakfa,[3] Danielle Boule,[4] Celine Belguendouz,[3] Rayane Kafi,[3] Sung-Joo Yuh,[4] Daniel Shedid,[4] Zhi Wang.[4]*** **From the [1]Dr. Georges-L.-Dumont University Hospital Centre, Moncton, N.B.; [2]Sherbrooke University, Sherbrooke, Que.; [3]Université de Montréal, Montréal, Que.; the [4]Centre hospitalier de l'Université de Montréal, Montréal, Que.; the [5]University of Ottawa, Ottawa, Ont.**

Background: There is a lack of clear evidence regarding neurological outcomes in patients with cancer presenting with pathologic vertebral fracture and neurological compromise. This widens the grey zone in surgical indications for these patients and increases the room for the surgeon's subjective input. **Methods:** This retrospective study included consecutive patients with pathologic spine fractures and neurologic compromise (American Spinal Cord Injury Association [ASIA] grade D, C, B or A) who underwent posterior spinal decompression and fusion with transpedicular corpectomy and cement-based reconstruction. Patients' charts were reviewed for demographic, medical and surgical-related data as well as postoperative outcomes at 6 weeks' follow-up. The main outcome was an improvement of at least 1 grade on the ASIA scale. Multivariate analysis was performed to look for predictive factors of this neurologic improvement. **Results:** A total of 246 patients (43.7% females) were included. Of those, 195 patients had ASIA score D, 37 had ASIA score C, 10 had ASIA score B, and 4 had ASIA score A. Neurological improvement occurred in 77 patients (31.2%). Of these patients, there were 45/195 ASIA D (23.1%), 25/37 ASIA C (67.6%), 6/10 ASIA B (60%) and 1/4 ASIA A (25%). Mean age of patients who improved was 60.1 years, compared to 65.5 years for those who did not ($p = 0.03$). Of patients with thoracic compression, 36.3% improved, compared to 24% of patients with lumbar compression ($p = 0.02$). Multivariate analysis showed that healthier patients with lower American Society of Anesthesiologists (ASA) grade preoperatively ($p < 0.01$), younger patients ($p = 0.02$), those with thoracic spine compression ($p = 0.04$) and those with lower initial ASIA score had significantly higher chances of postoperative neurological improvement. Time to surgery, patient's sex, preoperative sphincter function and duration of surgery did not affect the postoperative neurological outcome. **Conclusion:** Despite already known favourable outcomes in patient with ASIA score D, postoperative neurologic improvement is expected to occur in patients with spine pathologic fractures and ASIA C or B scores, particularly if these patients were younger, healthy (ASA grade < 3) and presented with a thoracic spine compression.

P-120
Abstract ID 116

Could patients' neurological status deteriorate after posterior decompression and fusion for unstable vertebral pathologic fractures? ***Zhi Wang,[1] Jesse Shen,[1] Ghassan Boubez,[1] Fidaa Alshakfa,[2] Daniele Boulé,[2] Celine Belguendouz,[2] Rayane Kafi,[2] Philippe Phan,[3] Daniel Shedid,[1] Sung-Joo Yuh,[2] Maroun Rizkallah.[2,4,5]*** **From the [1]Centre hospitalier de l'Université de Montréal, Montréal, Que.; the [2]Université de Montréal, Montréal, Que.; the [3]University of Ottawa, Ottawa, Ont.; the [4]Dr. Georges-L.-Dumont University Hospital Centre, Moncton, N.B.; [5]Sherbrooke University, Sherbrooke, Que.**

Background: In some instances, surgical candidates deteriorate neurologically postoperatively after unstable pathologic vertebral fracture despite eventless surgery. Even though this complication is well known and dreaded by surgeons, predictive factors for this neurological compromise have never been looked for. **Methods:** This retrospective study included consecutive patients with pathologic spine fractures and American Spinal Cord Injury Association (ASIA) score E, D, C or B who underwent posterior spinal decompression and fusion with transpedicular corpectomy and cement-based reconstruction, based on their neurological compromise or Spinal Instability Neoplastic Score (SINS) score. Patients' charts were reviewed for demographic, medical and surgical-related data as well as postoperative outcomes at 6 weeks of follow-up. The main outcome was a decline of at least 1 grade on ASIA scale. Multivariate analysis was performed to look for predictive factors for this neurologic regression. **Results:** A total of 409 patients (46.0% females) were included. Of those, 164 (40.1%) had ASIA score E, 205 (50.1%) had ASIA score D, 37 (9.1%) had ASIA score C and 3 (0.7%) had ASIA score B. Neurological deterioration occurred in 54 patients (13.2%). Of these patients, there were 32/164 ASIA E (19.5%), 20/205 ASIA D (9.8%) and 2/37 ASIA C (5.4%). Mean age of patients who deteriorated postoperatively was 63.7 years, compared to 62.6 years for those who did not (p = 0.40). Of patients with thoracic compression, 16.4% deteriorated, compared to 11.7% of patients with lumbar compression (p = 0.04). Mean surgical time averaged 233 minutes for patients who deteriorated postoperatively, whereas it reached 192.3 minutes for patients who did not (p = 0.048). Multivariate analysis showed that diabetic patients (p = 0.04), those who underwent a longer surgery (p = 0.03), those with thoracic compression (p = 0.029) and those with better ASIA score (p < 0.01) were at increased risk of postoperative neurological compromise. ASA score, smoking status and delay to surgery did not affect the neurological outcome. **Conclusion:** Risk of neurological compromise is significant and should be kept in mind while discussing outcomes and expectations in this frail patient population. Particular attention should be paid toward diabetic patients, those initially neurologically intact and those with thoracic compression.

P-122
Abstract ID 50

Challenging decision-making in spinal firearm and stab injuries: case series from a Brazilian trauma centre. ***Yan Gabriel Morais David Silva, Luis Weber, Felipe Leão.* From the Hospital Geral do Estado, Salvador, Brazil.**

Background: Urban violence in developing countries is a significant problem that results in daily victims. Firearm and stab injuries pose a formidable challenge for spine surgeons. The aim of this study was to discuss complex therapeutic decisions in extreme cases of firearm and stab injuries managed at a trauma centre in Brazil. **Methods:** Case 1: A 20-year-old male with a gunshot wound to the mouth was intubated and immobilized. Esophageal injury was suspected on general surgery evaluation, but neurological function remained intact. Computed tomography revealed a projectile fragment in the anterior space between the atlas and the basium. Expectant management was chosen, and the patient had a favourable outcome. Case 2: A 30-year-old male presented with a stab wound to the posterior neck, without neurological deficits. Cervical angiography indicated a knife fragment located approximately 1 mm from the V2 segment of the right vertebral artery. Surgical intervention was performed, resulting in a successful removal of the foreign body. Case 3: A 30 year-old male sustained a gunshot wound to the spine, leading to partial deficit, at the level of L1. The entry wound was in the thoracolumbar region, and imaging revealed a projectile lodged in the lumbosacral canal. Surgical removal of the projectile was opted for, and, during the procedure, the projectile was found to be intradural, necessitating a durotomy for extraction. **Results:** The uniqueness of each case presents a challenging decision-making process. As Bono et al. found, anatomical considerations, such as proximity to critical structures, as well as biomechanical stability play a crucial role in treatment decisions. The most effective strategy remains prevention and the implementation of public policies. We believe that atypical cases should be discussed with patients and their families whenever possible. **Conclusion:** This study underscores the complexity of managing spinal firearm injuries, with each case requiring a tailored approach and careful evaluation of various clinical and ethical factors. It also highlights the importance of preventive measures and open communication with patients and their families.

P-123
Abstract ID 55

Trends and impact of pharmacological venous thromboembolism prophylaxis timing for complete traumatic cervical spinal cord injury across North American trauma centres from 2013 to 2020. ***Ahmad Essa,[1] Armaan K. Malhotra,[1] Husain Shakil,[1] James Byrne,[2] Jetan Badhiwala,[1] Avery B. Nathens,[3] Tej D. Azad,[3] Eva Yuan,[1] Yingshi He,[1] Andrew S. Jack,[4] Francois Mathieu,[4] Jefferson R. Wilson,[1] Christopher D. Witiw.[1]* From the [1]Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ont.; the [2]Department of Surgery, Johns Hopkins Hospital, Baltimore, Md.; the [3]Department of Neurosurgery, Johns Hopkins Hospital, Baltimore, Md.; the [4]Interdepartmental Division of Critical Care, University of Toronto, Toronto, Ont.**

Background: This study aimed to evaluate the timing and trend of venous thromboembolism (VTE) prophylaxis initiation following surgical intervention and its impact on the occurrence of VTE complications across North American trauma centres for patients with complete traumatic cervical spinal cord injury (SCI). **Methods:** This retrospective observational cohort study utilized data from the American College of Surgeons Trauma Quality Improvement Program from 2013 to 2020. We identified surgically treated patients with complete traumatic cervical SCI. Outcomes of interest included time to VTE prophylaxis following surgery, the occurrence of VTE complications and rates of unplanned return to the operating room. Mixed-effects regression models were constructed to evaluate the adjusted estimate for each outcome, accounting for patient-, injury- and hospital-level covariates. **Results:** We identified 5325 eligible patients treated across 463 trauma centres. The mean time to VTE prophylaxis administration was 3.4 (standard deviation 4.6) days. The annualized trend of VTE prophylaxis administration after surgery decreased by 0.2 days (4.8 h) per year over the 8-year study interval. This was associated with a decreasing VTE complication rate

of 0.9% per annum. Multivariable mixed-effects regression models demonstrated significant reduction in time to VTE prophylaxis (mean difference –0.13, 95% confidence interval [CI] –0.22 to –0.04) and VTE complications (odds ratio [OR] 0.93, 95% CI 0.88 to 0.99) over the study period after adjustment. There was no significant difference in the rate of unplanned return to the operating room during the study period (OR 1.15, 95% CI 0.96 to 1.35). **Conclusion:** This analysis provides insight into VTE prophylaxis practice patterns following surgery for complete cervical SCI across North American trauma centres from 2013 to 2020. The trend in the timing of administration of VTE prophylaxis consistently decreased, which appeared to be associated with a significant reduction in VTE-related complications with no change in unplanned return to the operating room.

P-124
Abstract ID 58

Standardizing a magnetic resonance imaging library of acute traumatic spinal cord injury in Canada. ***Michael Craig*[1] *Nick Guenther*[2] *Jan Valosek*[2,3,4,5] *Maxime Bouthillier*[2] *Naga Karthik Enamundram*[2,3] *Naama Rotem-Kohavi*[6] *Suzanne Humphreys*[6] *Sean Christie*[7] *Michael Feblings*[8,9] *Brian Kwon*[10,11] *Jean-Marc Mac-Thiong*[12,13] *Philippe Phan*[14] *Jerome Paquet*[15] *Mathieu Guay-Paquet*[2] *Julien Cohen-Adad*[2,3,16,17,18] *David Cadotte*[19] From the [1]Combined Orthopaedic and Neurosurgical Spine Program, University of Calgary, Calgary, Alta.; the [2]NeuroPoly Lab, Institute of Biomedical Engineering, Polytechnique Montréal, Montréal, Que.; [3]Mila – Quebec AI Institute, Montréal, Que.; the [4]Department of Neurosurgery, Faculty of Medicine and Dentistry, Palacky University Olomouc, Olomouc, Czech Republic; the [5]Department of Neurology, Faculty of Medicine and Dentistry, Palacky University Olomouc, Olomouc, Czech Republic; the [6]Praxis Spinal Cord Institute, Vancouver, B.C.; the [7]QE II Health Sciences Centre, Halifax, N.S.; the [8]Division of Neurosurgery, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, Toronto, Ont.; the [9]Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ont.; the [10]Vancouver Spine Institute, Vancouver General Hospital, Vancouver, B.C.; the [11]Department of Surgery, University of British Columbia, Vancouver, B.C.; the [12]Department of Surgery, Hôpital du Sacré-Cœur de Montréal, Montréal, Que.; the [13]Department of Surgery, Université de Montréal, Montréal, Que.; the [14]University of Ottawa, the Ottawa Hospital, Ottawa, Ont.; the [15]Centre du Recherche CHU de Quebec, CHU de Québec, Université Laval, Québec, Que.; the [16]Centre Hospitalier de l'Université de Montréal, Université de Montréal, Montréal, Que.; the [17]Functional Neuroimaging Unit, CRIUGM, Université de Montréal, Montréal, Que.; the [18]Centre de Recherche du CHU Sainte-Justine, Université de Montréal, Montréal, Que.; the [19]Department of Clinical Neurosciences, University of Calgary, Calgary, Alta.**

Background: As surgeons, we utilize magnetic resonance imaging (MRI) data for diagnostic and surgical planning purposes. MRI also has potential to detect residual, uninjured spinal cord tissue, and potentially stratify patients for inclusion into clinical trials based on the extent to which their spinal cord tissue has been damaged. However, sample sizes from single hospitals are constrained, and the management of MRI data is hospital-specific, rendering the federation of multicentre data sets a difficult task. In this work, we standardized a library of MRI data to develop lesion segmentation algorithms that may be potentially useful for characterizing spinal cord injury (SCI) severity and understanding the heterogeneity of injury. **Methods:** A total of 487 individuals across Canada who suffered a traumatic cervical SCI between 2015 and 2021 and were previously enrolled in the Rick Hansen Spinal Cord Injury Registry were selected for inclusion in the National Canadian SCI Imaging Repository. Research ethics approval was obtained from each of the 8 participating sites to collect and review retrospective MRI data acquired within 72 hours of injury. The data were then anonymized and curated into a standardized format. **Results:** Individual patient DICOM data were extracted from local hospital servers and anonymized using open-source software packages (dcm2bids and requisite dependencies). Each hospital site then curated the anonymous imaging data into a single, accepted Brain Imaging Data Structure (BIDS) format, which standardizes the naming and structuring of MRI data. The BIDS library was then uploaded to our national repository for further processing. **Conclusion:** This work demonstrates a methodology for the batch use of imaging data to evaluate the effects of traumatic cervical SCI. Here, we protect the personal identifiable information of patients and utilize their clinical, routine imaging data to develop lesion segmentation algorithms that may be applied to future patients for classification or potential enrolment into novel clinical trials based on imaging characteristics of residual anatomy or specific spinal cord lesions such as edema or hemorrhage.

P-126
Abstract ID 69

Is the level of consent to a national research registry associated with patient outcomes following traumatic spinal cord injury? A population-based study from the Rick Hansen Spinal Cord Injury Registry (RHSCIR). ***Antoine Dionne*[1,2] *Jean-Marc Mac-Thiong*[1,2,3] *Heather Hong*[4] *Dilnur Kurban*[4] *Jijie Xu*[4] *Dorothy Barthélémy*[1,5] *Sean Christie*[6] *Daryl Fourney*[7] *Gary Linassi*[7] *Adalberto Loyola Sanchez*[8] *Jérôme Paquet*[9,10] *Vidya Sreenivasan*[11] *Andrea Townson*[12] *Eve C. Tsai*[13] *Andréane Richard-Denis.*[1,2] From the [1]Université de Montréal, Montréal, Que.; the [2]Centre de recherche de l'Hôpital du Sacré-Cœur de Montréal, Montréal, Que.; the [3]Centre Hospitalier Universitaire Sainte-Justine, Montréal, Que.; the [4]Praxis Spinal Cord Institute, Vancouver, B.C.; the [5]Centre de recherche interdisciplinaire en réadaptation de Montréal, Montréal, Que.; [6]Dalhousie University, Halifax, N.S.; the [7]University of Saskatchewan, Saskatoon, Sask.; the [8]University of Alberta, Edmonton, Alta.; [9]Université Laval, Québec, Que.; the [10]Centre Hospitalier Universitaire de Québec, Québec, Que.; the [11]Ottawa Hospital Rehabilitation Centre, Ottawa, Ont.; the [12]University of British Columbia, Vancouver, B.C.; the [13]Ottawa Hospital, Ottawa, Ont.**

Background: The Rick Hansen Spinal Cord Injury Registry (RHSCIR) is one of the largest longitudinal patient registries for spinal cord injury (SCI) research worldwide. In preliminary work

based on a subset of the RHSCIR, the authors have shown that patients who decline to participate in this voluntary registry are more likely to suffer from complications and present overall poorer health outcomes. The objective of this study was to determine if the level of participation to the RHSCIR is associated with the outcomes of patients with SCI based on the full RHSCIR data set. **Methods:** A retrospective cohort study was conducted using data from 2811 individuals with acute SCI who were prospectively enrolled in RHSCIR between 2014 and 2019. The independent variable of interest was the level of consent: provided full consent (PC) versus declined complete participation (but accepted minimal data collection) or withdrew consent (DWC) versus declined consent to any data collection (DC). Baseline characteristics and outcomes were compared between patients from the PC and DWC groups (and not the DC group since there was no data collection for this subset). Multivariable regressions were performed to determine if the level of consent (PC v. DWC) was independently associated with the outcomes while controlling for confounders. **Results:** Of the 2811 included patients, 2101 (74.7%) were in the PC group, 553 (19.7%) were in the DWC group, and 157 (5.6%) were in the DC group. Patients from the DWC group had significantly longer acute lengths of stay (LOS), developed more cases of pneumonia and pressure injuries during acute care, and were less likely to be discharged home from the hospital than patients from the PC group. All these associations — except for acute pneumonia — remained significant in the multivariable analyses. **Conclusion:** The level of consent to participate in longitudinal research was associated with several patient outcomes following traumatic SCI. In particular, patients who chose not to participate fully or who withdraw their consent tended to present with more acute complications and longer hospital LOS.

P-127
Abstract ID 78

Spinal cord injuries secondary to mountain biking accidents — a cause for national alarm. ***William Chu Kwan, Pedram Laghaei, Harsh Kahlon, Tamir Ailon, Raphael Charest-Morin, Charlotte Dandurand, Scott Paquette, Nicholas Dea, John Street, Charles G. Fisher, Marcel F. Dvorak, Brian K. Kwon.*** **From the Combined Neurosurgical and Orthopedic Spine Program, Department of Orthopaedic Surgery, University of British Columbia, Vancouver, B.C.**

Background: Mountain biking, an increasingly popular sport, can result in catastrophic spinal cord injury (SCI) with major physical, psychological and financial ramifications. While much attention is placed on hockey and collision sports as causes of SCI, in our experience, these are far less common than mountain biking. We aimed to characterize mountain biking SCI incidence and demographics, and to highlight personal and societal impacts of these injuries by estimating their financial burden. **Methods:** We conducted a retrospective chart review from 2008 to 2022 at Vancouver General Hospital for patients with SCI from off-road mountain biking. We compiled data on patient demographics, accident details, and clinical information. For each patient, acute direct (surgery, hospital admission, rehabilitation), lifetime direct (readmission to hospital, pharmaceuticals, home modification, caregiver services) and lifetime indirect costs were estimated using a prior study of annual resource use intensity for complete versus incomplete and paraplegia versus tetraplegia. Costs were inflation-adjusted. **Results:** Over the 15-year period, we identified 58 individuals who suffered an SCI while mountain biking. The average age was 35.5 years, 93% were male, 55% were married, and 85% were employed. The average combined cost (acute direct, lifetime direct and lifetime indirect) was $3.8 million, $4.1 million, $2.6 million and $1.6 million for complete tetraplegic (n = 14), complete paraplegic (n = 13), incomplete tetraplegic (n = 26) and incomplete paraplegic (n = 5), respectively. The total combined cost for each of these subgroups was $52.9 million, $54.8 million, $68.0 million and $8.0 million, respectively. The total cost for 58 patients amounted to $183.7 million. **Conclusion:** While ice hockey remains our "national pastime," and much awareness exists around hockey-related spine injuries, we did not manage a single SCI from hockey during this period, in which we treated nearly 60 mountain bikers, many being young with catastrophic injuries. The impact on individuals and families is challenging to quantify, but it has significant financial implications for the health care system. Given the Canada-wide popularity of mountain biking, our provincial experience likely reflects what is occurring nationally. Our data underscore the need for increased awareness, education and preventive measures to mitigate the burden of these severe injuries.

P-128
Abstract ID 85

Can the Montreal Acute Classification of Spinal Cord Injury (MAC-SCI) be used to detect early perioperative deteriorations following traumatic spinal cord injury? A validation study. ***Jérémie Thibault,[1,2] Antoine Dionne,[2,3] Mohamed Al-Sofyani,[4] Rémi Pelletier-Roy,[1,3] Andréane Richard-Denis,[2,3] Étienne Bourassa-Moreau,[1,3] Jean-Marc Mac-Thiong.[1,3,5]*** **From the [1]Department of Orthopedic Surgery, Université de Montréal, Montréal, Que.; the [2]Department of Medicine, Université de Montréal, Montréal, Que.; the [3]Research Centre, Hôpital du Sacré-Cœur, Montréal, Que.; the [4]Department of Surgery of Hail University, Hail, Saudi Arabia.; the [5]Sainte-Justine University Hospital Research Centre, Montréal, Que.**

Background: The Montreal Acute Classification of Spinal Cord Injury (MAC-SCI) is a recently developed tool to detect and characterize traumatic spinal cord injuries (TSCIs) in the acute trauma setting. In previous work, we have shown that the MAC-SCI is accurate and reliable in achieving its primary purpose while comprising only 53 elements (v. 134 in the original International Standards for Neurological Classification of Spinal Cord Injury [ISNCSCI]). This study aimed to evaluate if the MAC-SCI could also be used as a standardized and efficient method to detect perioperative neurological deterioration following TSCI. **Methods:** We conducted a retrospective chart review of all patients admitted for a TSCI between June 2018 and December 2021 at our level 1 trauma centre. Patients who had complete preoperative and postoperative ISNCSCI examinations were retained. Corresponding MAC-SCI examinations were derived from all the ISNCSCI worksheets. Sensitivity and specificity analyses were performed to evaluate the performance of the MAC-SCI to detect clinically significant deteriorations in

Neurological Level of Injury (NLI) (≥ 2 levels) and American Spinal Injury Association Impairment Scale (ASIA) grade (≥ 1 grade) between the preoperative and postoperative assessments, as seen with the ISNCSCI. **Results:** Thirty-five patients were retained for final analysis. For NLI, specificity and sensitivity for the MAC-SCI were calculated at 100% and 81.0%, respectively. For ASIA grade, both sensitivity and specificity were calculated at 100%. Changes in ASIA grade were identified by the MAC-SCI in 27 cases (77.7%) and missed in 3 cases (8.6%). Change in NLI was falsely identified in 1 case (2.9%). MAC-SCI identified all changes in grade severity. There were no differences in the NLI in 22 cases between MAC-SCI and ISNCSCI for pre- and postoperative scores. The average NLI difference in the remaining 13 cases was 1.38 (standard deviation 0.65) between the pre- and postoperative scores. **Conclusion:** We found that the MAC-SCI was a reliable classification tool to evaluate the grade severity of a TSCI as well as the NLI within 1 level in the postoperative period. Therefore, this classification tool could be used to detect neurological deterioration by acute care clinicians.

P-129
Abstract ID 87

Building of a national Canadian magnetic resonance imaging repository for deep-learning segmentation of edema and hemorrhage. ***Maxime Bouthillier,[1] Jan Valošek,[1,2,3] Naga Karthik Enamundram,[1,2] Mathieu Guay-Paquet,[1] Nick Guenther,[1] Naama Rotem-Kohavi,[4] Suzanne Humphreys,[4] Sean Christie,[5] Michael Feblings,[6,7] Brian K. Kwon,[8,9] Jean Marc Mac-Thiong,[10,11] Philippe Phan,[12] David Cadotte,[13,14] Julien Cohen-Adad.[1,2,15,16]*** **From the [1]NeuroPoly Lab, Institute of Biomedical Engineering, Polytechnique Montréal, Montréal, Que.; [2]Mila – Quebec AI Institute, Montréal, Que.; the [3]Department of Neurosurgery, Faculty of Medicine and Dentistry, Palacký University Olomouc, Olomouc, Czech Republic; the [4]Praxis Spinal Cord Institute, Vancouver, B.C.; the [5]QE II Health Sciences Centre, Halifax, N.S.; the [6]Division of Neurosurgery, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, Toronto, Ont.; the [7]Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ont.; the [8]Vancouver Spine Institute, Vancouver General Hospital, Vancouver, B.C.; the [9]Department of Surgery, University of British Columbia, Vancouver, B.C.; the [10]Department of Surgery, Hôpital du Sacré-Cœur de Montréal, Montréal, Que.; the [11]Department of Surgery, Université de Montréal, Montréal, Que.; the [12]University of Ottawa, The Ottawa Hospital, Ottawa, Ont.; the [13]Division of Neurosurgery, Department of Clinical Neurosciences, University of Calgary, Calgary, Alta.; the [14]University of Calgary Combined Spine Program, Calgary, Alta.; the [15]Functional Neuroimaging Unit, CRIUGM, Université de Montréal, Montréal, Que.; the [16]Centre de Recherche du CHU Sainte-Justine, Université de Montréal, Montréal, Que.**

Background: The main goal of this study is to set up a pan-Canadian multicentre repository of preoperative magnetic resonance imaging (MRI) examinations of patients with acute traumatic spinal cord injury (tSCI). The repository will serve to develop an automated segmentation method on "real-world" clinical data of patients with tSCI. A secondary goal was to assess the feasibility of obtaining the edema and hemorrhage within the lesions as distinct segmentations from sagittal T_2-weighted MRI images. **Methods:** Clinical MRI examinations of 487 individuals from 8 sites across Canada, acquired within 72 hours after injury, are being added to the National Canadian Imaging Repository. Data curation to the Brain Imaging Data Structure (BIDS) standard is performed at each site to ensure standardization of images across sites. Two raters have been completing data quality control and manual segmentation of sagittal T_2-weighted images with the distinction of presumed edema and hemorrhage. The manual segmentations will serve as the ground truth for developing a deep learning–based segmentation method. **Results:** Data from 52 participants from 3 of the 8 sites have been visually assessed. From the user's perspective, the manual segmentation process demonstrated that presumed hemorrhagic lesions, characterized by their discontinuity, posed greater challenges and were more time-consuming for accurate segmentation compared to presumed edema. While a comprehensive examination of all patients' MRI sequences offers more precise insights into the nature of signal abnormalities, this approach seems unfeasible in the scale of building such a large repository. Another segmentation model was trained using mainly postoperative T_2-weighted images but did not perform well on the preoperative data. **Conclusion:** The first large pan-Canadian repository of preoperative clinically acquired acute cervical tSCI MRI examinations is being set up. Despite the time-consuming nature of manually segmenting edema and hemorrhage, this process is a critical initial step in the development of deep-learning models.

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Abstract ID 134

Functional and patient-reported outcomes following peripheral nerve transfers to improve upper limb function in individuals with cervical spinal cord injury. ***Luke Reda,[1] Colton Kennedy,[1] Stephanie Stefaniuk,[1] Parvin Eftekhar,[2] Larry Robinson,[1] Cathy Craven,[2] Jana Dengler.[1]*** **From the [1]Sunnybrook Health Sciences Centre, Toronto, Ont.; the [2]University Health Network, Toronto, Ont.**

Background: The objective was to assess functional and patient-reported outcomes following nerve transfer surgery to improve upper limb function in individuals with cervical spinal cord injury (SCI) at a single centre. **Methods:** Data were collected in a prospective fashion from individuals with cervical SCI referred to the Spinal Cord Injury Clinic at Sunnybrook Health Science Centre who underwent at least 1 nerve transfer procedure. Baseline preoperative assessments were performed, as well as 6-, 12-, 18- and 24-month postoperative outcomes assessments. Assessments included muscle strength grading, pinch and grip, GRASSP, Spinal Cord Independence Measure, Canadian Occupational Performance Measure, Health Utility Index, Work Productivity and Impairment questionnaire and a quality-of-life measure (Life Satisfaction Questionnaire 11/EuroQoL). **Results:** A total of 59 individuals with cervical SCI have been assessed since 2019, of whom 28 were deemed surgical candidates based on mechanism of injury, time from injury, level of injury, physical examination, and electromyography and nerve conduction study testing. To date, a total of 16 individuals have undergone surgery in a total of

24 limbs, and 49 nerve transfers were performed. Postoperative follow-up is ongoing. **Conclusion:** Data collection and analysis is still ongoing. We plan to compare both standardized strength testing as well as patient-reported outcome measures for the duration of available follow-up. Our goal is to assess the efficacy of nerve transfers in patients with cervical SCI through the analysis of the data collected from our cohort of patients.

P-133
Abstract ID 135

Assessing the efficacy of a novel multidisciplinary outpatient program for improving upper limb function in cervical spinal cord injury. ***Colton Kennedy*,[1] *Luke Reda*,[1] *Stephanie Stefaniuk*,[1] *Parvin Eftekhar*,[2] *Larry Robinson*,[1] *Cathy Craven*,[2] *Jana Dengler*.[1] From the [1]Sunnybrook Health Sciences Centre, Toronto, Ont.; the [2]University Health Network, Toronto, Ont.**

Background: The objective was to assess the efficacy of a multidisciplinary spinal cord injury (SCI) clinic at a Canadian level 1 trauma centre for improving upper limb function in cervical SCI injury, with regard to referral rates, wait times, and volumes of patients assessed and treated. **Methods:** Data have been collected in prospective fashion since the inception of this multidisciplinary effort in October 2019 at a single centre. The Sunnybrook Health Sciences Centre Spinal Cord Injury Clinic in collaboration with Toronto Rehabilitation Institute – Lyndhurst Centre is a novel multidisciplinary clinic comprising physical medicine and rehabilitation, plastic surgery, spine surgery and physical therapy specialists. Data collected include patient demographics (age, gender, date of injury, mechanism of injury, level of injury), source of referral, time from initial injury to consultation, time from injury to surgical intervention and surgical interventions performed. **Results:** Fifty-nine individuals with cervical SCI have been referred to and assessed by the SCI clinic, with the vast majority referred from the trauma and spine programs, as well as from Lyndhurst, an SCI rehabilitation centre. Most patients were referred close to the time of injury (average 5.3 mo), with a small number of late referrals years out from injury. Among the 59 referrals, 28 individuals were deemed surgical candidates for nerve transfers. To date, 16 individuals have undergone surgical intervention for nerve transfers, totalling 24 limbs and 49 nerve transfers. **Conclusion:** Our goal is to demonstrate the efficacy of this novel multidisciplinary clinic for individuals with cervical SCI based on referral volume, patient demographics, time from injury to consultation, and time from injury to surgical intervention. We are also collecting and will report on reasons for operative candidates drop-out (e.g., patient refusal, loss to follow-up). The clinic is continuing to accept new referrals and is seeing patients on a monthly basis.

P-134
Abstract ID 153

Assessing neural stem progenitor cell proliferation: identifying effective predictors. ***Maryam Rezaeezadeh Roukerd*,[1] *Maitreya Patel*,[1] *Eve Tsai*,[1,2] *Ahmad Galuta*,[1] *Sasi Jagadeesan*,[1] *Ryan Vimukthie Sandarage*.[2] From the [1]Neuroscience Program, Ottawa Hospital Research Institute, Ottawa, Ont.; the [2]Division of Neurosurgery, Department of Surgery, The Ottawa Hospital, Ottawa, Ont.**

Background: We evaluated the proliferation rate of neural stem progenitor cells (NSPCs) from human spinal cord tissue and compared it with various predictors and comorbidity to determine which parameter can effectively characterize the proliferative characteristics of NSPCs. **Methods:** NSPCs were extracted from spinal cord organ donors. For calculating doubling proliferation rate, we used the following formula: Days in vitro*(Ln(2)/Ln(final number of NSPCs)/initial number of NSPCs). The results were evaluated by different predictors and comorbidity. Results were analyzed with the GraphPad Prism *t* test and analysis of variance (p value < 0.05). **Results:** The average value of the total cell proliferation doubling rate was 6.13 (standard deviation 2.03). The result indicated that the rate of doubling of NSPCs did not show a significant correlation with the spinal cord region or the gender, age, comorbidity of neurological conditions or substance use of organ donors (p < 0.6, 0.13, 0.15, 0.88 and 0.56, respectively). **Conclusion:** The results of this study indicated that the NSPC proliferation rate did not have a significant correlation with gender. The NSPC proliferation rate did not differ significantly in the lumbar and thoracic regions. The comorbidity results of this study did not show a correlation compared to normal subjects. The results of this study may reveal NSPC behaviour in cultured medium, although larger sample sizes and additional studies may be needed to confirm these correlations and further explore potential factors influencing NSPC proliferation.

P-136
Abstract ID 159

Identifying care pathways of patients with traumatic spinal cord injury using novel AI methods. ***Philippe Phan*,[1] *Wojtek Michalowski*,[2] *William Van Woensel*.[3] From the [1]Ottawa Hospital, Civic Campus, Ottawa, Ont.; the [2]Telfer School of Management, University of Ottawa, Ottawa, Ont.; the [3]University of Ottawa, Ottawa, Ont.**

Background: Patients with traumatic spinal cord injury (tSCI) go through a series of events — also referred to as a care pathway — including tests, surgeries, rehabilitation and follow-up, often at different care facilities. We suspect that standards of care for tSCI often differ in practice, not just among provinces but also facilities, as there are currently no universal guidelines on most efficient tSCI care pathways. We aimed to gain insights into current interinstitutional and interprovincial tSCI pathways using data from a national registry maintained by the Praxis Institute. Our long-term goal is to identify potential quality and efficiency issues, which will eventually contribute to improved patient care. **Methods:** We used novel AI methods to discover and analyze common tSCI pathways that map facility, care unit stays and concrete interventions. We used a subset of 1283 patients with complete lower cervical injuries (C5–C8) from the Rick Hansen Spinal Cord Injury Registry (RHSCIR), which covers 30 major Canadian trauma and rehabilitation centres. We extracted an event log where each event records a case identification, care activity or facility visit, and timestamp, and used this as the basis for our analysis. **Results:** While most of the patients with complete lower cervical injuries followed similar care pathways, there

are relevant differences between provinces. For example, Newfoundland and Labrador has the highest reported mortality rate during acute care, and patients spend relatively more time in acute care and rehabilitation. Patients in Ontario and Alberta spend relatively more time in acute care but less in rehabilitation compared to other provinces. **Conclusion:** Our preliminary observations confirm our hypothesis that care pathways for patients with tSCI are influenced by province-specific factors. We are working on an extended study report to gain better insights regarding underlying causative factors. This could provide insight for a first step toward developing nationwide guidelines for treating patients with complete lower cervical injuries.

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Abstract ID 160

Ski- and snowboard-related spinal trauma and spinal cord injury: a northeastern level 1 trauma experience. ***Khushdeep Vig,[1] Jillian Kazley,[2] Abdul Arain,[3] Gabriella Rivas,[4] Robert Ravinsky,[4] James Lawrence.[4]*** **From the [1]University of Louisville, Louisville, Ky.; [2]Boston University, Boston, Mass.; [3]One Oak Medical, Wayne, N.J.; [4]MUSC, Charleston, S.C.**

Background: Recreational and competitive skiers are prone to spinal injuries. Improved equipment, increased terrain difficulty and more advanced skiing manoeuvres may have led to an increase in the frequency and severity of spinal injuries. There is a paucity of data on the epidemiology of spinal injuries resulting from skiing. The goal of this study was to analyze the traumatic spine injuries in skiers treated at a level 1 trauma centre. **Methods:** A retrospective review of patients admitted with traumatic spinal injuries revealed 60 cases of trauma from skiing between January 2015 and March 2019. Data on demographics, vertebral level, fracture mechanism, fracture type, spinal cord injury, American Spinal Cord Injury Association (ASIA) score, management, concomitant injuries and involvement of other surgical services were collected. **Results:** Injuries by region were distributed as 33.3% cervical, 57% thoracic and 38.0% lumbosacral spine; 75% of patients injured a single region, 21.7% had 2 regions involved, and 3.3% injured all 3. Single-level injuries occurred in 38% of patients. More than one-quarter of patients (27%) suffered spinal cord injury; 81% of those had neurological compromise, with a rate of full neurological resolution at discharge of 53.8%. Two-thirds of fractures (65%) were compression-type. Management included operative treatment with decompression and fusion in 32% of patients. Those with cervical spinal injuries were more likely to sustain an extension–distraction type of fracture and concomitant spinal cord injury. Patients with thoracic spine injury were more likely to have multiple vertebral levels involved. Patients with lumbosacral involvement were more likely to sustain compression type and transverse process fractures. Patients with spinal trauma to all 3 spinal regions were more likely to have translational/rotational injuries, facet fractures, lamina and pedicle fractures, and traumatic anterolisthesis. **Conclusion:** Skiing injuries can be devastating, potentially resulting in permanent neurological compromise and spinal instability. Although further large-scale multicentre studies are necessary, orthopedic surgeons as well as the general population can potentially benefit from improving their understanding of the dangers of skiing as it pertains to spinal trauma.

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Abstract ID 161

Robot-assisted needle injection for biomaterial delivery in treating spinal cord injury. ***Shaurya Gupta,[1,2] Jibrahn Patel,[3] Isaac Turkstra,[3] Kirill Pustovetov,[3] Victor Yang.[2]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]London Health Sciences Centre, London, Ont.; the [3]Toronto Metropolitan University, Toronto, Ont.**

Background: Spinal cord injury (SCI) is a devastating condition with limited treatment options. A complex injury microenvironment and formation of a glial scar pose significant challenges in axonal regeneration. A potential solution to facilitate regeneration of nerve fibres is to use a biomaterial scaffold (bridge) at the lesion site as a pathway for growing axons across the lesion and as a platform to deliver drugs. This study aimed to investigate the efficacy of robot-assisted needle injection for precise and targeted delivery of an injectable bridge. **Methods:** A novel injector system was developed, integrating robotic technology and electromagnetic positioning for precise needle placement. Phantom models of SCI were established, and an injectable biomaterial was injected at preplanned positions and depths. Accuracy of injectate placement was evaluated using image analysis of fluoroscopic images. To evaluate in vivo feasibility, injections were made into a cadaveric porcine model at preplanned positions. Ultrasonography imaging was used to monitor the injection process in both phantom and porcine models. A total of 50 injections were made, testing needle placement accuracy. Additionally, a comparison to manual injection was made. **Results:** Robot-assisted needle injection demonstrated a needle placement accuracy of 1.5 mm (standard deviation 0.5 mm) (note: since this study is ongoing, final accuracy numbers may vary). Robot-assisted needle injection demonstrated significantly improved accuracy and consistency in delivering biomaterials to the preplanned injection site in comparison to manual techniques. Ultrasonography imaging permitted visualization of the injection site, enabling the operator to observe the procedure and visualize injectate on injection. **Conclusion:** Robot-assisted needle injection has been demonstrated to offer a highly effective and reliable method for targeted biomaterial delivery in SCI treatment. The precise deposition and visualization of injected biomaterial at the planned injection site demonstrated potential for clinical translation. This novel technique offers new avenues for improving outcomes for patients with SCI and advancing the field of regenerative medicine. Further studies are warranted to optimize the technique in live in vivo porcine models.

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Abstract ID 5

Impact of tobacco on nonunion rate and patient-reported outcomes in spinal fusion surgery: a systematic review and meta-analysis. ***W. Bradley Jacobs,[1] Gonzalo Mariscal,[2] Christopher D. Witiw,[3] James S. Harrop,[4] Ahmed Essa.[5]*** **From the [1]Calgary Spine Program and Division of Neurosurgery, Cumming School of Medicine, University of Calgary, Calgary, Alta.; the [2]Mediterranean Observatory for Clinical and Health Research, Valencia, Spain; the [3]University of Toronto, Toronto, Ont.; [4]Departments of Neurological and Orthopedic Surgery, Thomas Jefferson University, Philadelphia, Pa.**

Background: Pseudarthrosis after spinal fusion surgery is a prevalent adverse event, imparting substantial clinical and economic burden, and leading to worse patient-reported outcomes. This systematic review with meta-analysis was aimed at evaluating the impact of smoking on spinal fusion rates and the resulting patient-reported outcome measures (PROMs). **Methods:** Following the PRISMA guidelines, we conducted a systematic literature search in 4 databases. Studies focused on adults undergoing spinal fusion that compared smokers versus nonsmokers were included. The primary outcomes assessed were nonunion/pseudarthrosis incidence and PROMs, including Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), EuroQol-5D (EQ-5D), 12-Item Short Form Survey (SF-12), 36-Item Short-Form Health Survey (SF-36), return to work and satisfaction measured by the North American Spine Society Lower Back Pain instrument. Odds ratios (ORs) were calculated for dichotomous variables, and mean differences or standardized mean differences for continuous variables. **Results:** A total of 29 studies were included in this analysis. The unadjusted incidence of pseudarthrosis was significantly higher in smokers than in nonsmokers (OR 1.97, 95% confidence interval [CI] 1.55–2.52, $p < 0.001$). Subgroup analysis revealed significant differences in the cervical (OR 2.09, 95% CI 1.27–3.44, $p < 0.05$) and lumbar (OR 1.97, 95% CI 1.45–2.68, $p < 0.001$) regions. Adjusted analysis also showed a significantly higher incidence of pseudarthrosis in smokers (OR 1.38, 95% CI 1.12–1.72, $p < 0.05$). Patient ODI, VAS, EQ-5D, SF-12 and SF-36 scores consistently favoured nonsmoking patients. Smoking was associated with a lower rate of returning to work (OR 0.70, 95% CI 0.54–0.90, $p < 0.05$) and reduced satisfaction (OR 0.24, 95% CI 0.12–0.49, $p < 0.001$). Former smokers (smoking cessation for at least 1 yr prior to surgery) did not show significant differences compared to nonsmokers in nonunion rate or pain scores. **Conclusion:** Smoking is associated with an increased risk of nonunion and lower PROMs after spinal fusion surgery. Health care providers should emphasize smoking cessation interventions to improve surgical outcomes and patient satisfaction.

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Abstract ID 6

The economic burden of diabetes in spinal fusion surgery: a systematic review and meta-analysis. ***Christopher D. Witiw,[1] Gonzalo Mariscal,[2] W. Bradley Jacobs,[3] James S. Harrop,[4] Ahmed Essa.[5]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]Mediterranean Observatory for Clinical and Health Research, Valencia, Spain; the [3]Calgary Spine Program and Division of Neurosurgery, Cumming School of Medicine, University of Calgary, Calgary, Alta.; the [4]Departments of Neurological and Orthopedic Surgery, Thomas Jefferson University, Philadelphia, Pa.; the [5]University of Toronto, Toronto, Ont.**

Background: The cost and value of specific surgical procedures are not uniform across all populations. Diabetes mellitus (DM) is known to increase costs for patients undergoing spinal surgery and decrease surgical outcomes. Although studies have evaluated the cost impact of DM in spinal surgery, we performed a meta-analysis controlling for confounding variables to evaluate this on a broader spectrum. This study aimed at comparing the costs of spinal fusion surgery between patients with and without DM. **Methods:** Following PRISMA guidelines, we conducted a systematic search of 4 databases. A meta-analysis was performed on comparative studies examining diabetic versus nondiabetic adults undergoing cervical/lumbar fusion in terms of cost. Heterogeneity was assessed using the I^2 test. Standardized mean differences (SMDs) and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated using a random-effects model in the presence of heterogeneity. **Results:** A total of 22 studies were included in this meta-analysis. Standardized costs were significantly higher in the diabetic group (SMD 0.02, 95% CI 0.01–0.03, $p < 0.05$). The excess cost per diabetic patient undergoing spinal fusion surgery was estimated to be $2492 (95% CI $1620–$3363). The length of stay (LOS) was significantly longer in the DM group (MD 0.42, 95% CI 0.24–0.60, $p < 0.001$). No significant difference was observed in intensive care unit admission between the groups (OR 4.15, 95% CI 0.55–31.40, $p > 0.05$). Reoperation showed no significant differences between the groups (OR 1.14, 95% CI 0.96–1.35, $p > 0.05$). However, 30-day and 90-day readmissions were significantly higher in the DM group (OR 1.42, 95% CI 1.24–1.62, $p < 0.05$, and OR 1.39, 95% CI 1.15–1.68, $p < 0.001$, respectively). Nonroutine or nonhome discharge was also significantly higher in the DM group (OR 1.89, 95% CI 1.67–2.13, $p < 0.001$). **Conclusion:** This meta-analysis revealed that patients with DM undergoing spinal fusion surgery had increased costs, prolonged LOS, increased 30-day and 90-day readmission rates, and more frequent nonroutine discharges than patients without DM.

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Abstract ID 47

Integration of a self-evaluation tool into surgical case logs for tracking spine fellow progress. ***Jin Tong Du,[1] Ahmed Cherry,[1] Rajesh Kumar,[1] Nadia Jaber,[1] Michael Fehlings,[1,2] Albert Yee.[1,3]*** **From the [1]Department of Surgery, University of Toronto, Toronto, Ont.; the [2]Division of Spine Surgery, University Health Network, Toronto, Ont.; the [3]Division of Spine Surgery, Sunnybrook Health Sciences Centre, Toronto, Ont.**

Background: Spine surgery training requires an orthopedic or neurosurgery residency and a subspecialty fellowship. Unlike residencies, most spine fellowship curricula are not formalized and evaluated. Our institution uses a nationally based curriculum and has implemented standardized surgical case logs to evaluate procedural competencies. In this study, we aimed to assess the confidence and competence of spine fellows in various surgical cases using case logs and demonstrate its utility as an evaluation tool. **Methods:** Data were extracted from fellow-reported surgical case logs from 2015 to 2023. A short Likert scale survey assessed personal learning, confidence and competence on a scale of 1 to 5. Lower scores indicated less personal learning, lower confidence and lower ability to complete the task adequately. **Results:** Surgical case logs from 39 fellows were collected from 2015 to 2023, with a total of 6971 cases logged. Mean number of cases logged per fellow (± standard deviation) was 178 (± 74). The average self-reported confidence was 3.74 (± 0.99), and the average competence was 3.61 (± 1.17). A positive correlation existed between confidence and competence ($R^2 = 0.86$). The most common primary surgical approach used was posterior, with 5301 cases with average reported confidence of 3.71 (± 1.01) and competence of 3.73 (± 1.02).

Conversely, a lesser-used lateral approach with only 24 logged cases had an average confidence of 2.88 (± 0.90) and competence of 2.79 (± 0.88). The most common class of diagnoses was degenerative/inflammatory, with 4272 cases with average reported confidence of 3.80 (± 0.98) and competence of 3.81 (± 0.99). The least common diagnosis was infectious, with 261 cases. The average confidence was 4.03 (± 0.93) and average competence was 3.99 (± 0.94). **Conclusion:** A standardized surgical case log is an effective and accepted way to document surgical exposure that can be leveraged in credentialing and accreditation processes. The self-evaluation survey gives administrators insight into the fellow's confidence and perceived competence in various surgical cases. This allows the program to adapt according to each fellow's needs while still operating within the competencies set out by the program.

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Abstract ID 64

Ligament damage models in the lumbar spine: modelling using a novel 3D-printable analogue model. ***Siril Teja Dukkipati,[1,2] Mark Driscoll.[1,2]*** **From the [1]Musculoskeletal Biomechanics Research Lab, Department of Mechanical Engineering, McGill University, Montréal, Que.; the [2]Orthopaedic Research Laboratory, Research Institute MUHC Montreal General Hospital, Montréal, Que.**

Background: Traditionally, biomechanical studies of the spine have been conducted using either cadavers or finite-element modelling techniques; however, both these approaches have limitations such as cost, ethics, variability across specimens, and simulation time. Validated analogue spine models could be used along with these traditional methodologies as cost-effective and high-fidelity alternatives. This research used one such analogue model developed previously to estimate the effect of ligaments on lumbar spine rotational stiffness. **Methods:** A 3D-printable analogue L1–S1 spine model was adapted to develop ligament damage models in the lumbar spine. The interspinous ligament was cut at the L4–L5 level to simulate an interspinous ligament tear. Similarly, the intertransverse ligament tear was created by dissecting the left and right intertransverse ligaments at the L4–L5 level. The interspinous ligament tear model was tested in flexion–extension, while the intertransverse tear model was loaded in lateral bending mode. Five cycles of sinusoidal pure moments up to amplitudes of 7.5 Nm at 1/60 Hz were applied before and after the damage. Range of motion (ROM) in the last 3 cycles was measured to calculate the rotational stiffness of the models. **Results:** At 7.5-Nm flexion, the healthy model had an ROM of 10.70°, while the interspinous ligament tear model had an ROM of 12.41°. Similarly, at 7.5-Nm extension, the healthy model had an ROM of 8.56°, and the damaged model had an ROM of 9.70°. A 6.13% increase in ROM was observed after intertransverse ligament damage. These results were comparable to in silico literature studies. No ex vivo studies of this kind were found in the literature. **Conclusion:** Loss of stiffness in interspinous and intertransverse ligaments significantly decreases flexion and lateral bending stiffness, respectively, in agreement with the current understanding of lumbar biomechanics. This research quantifies this effect with the help of these novel 3D-printable analogue models. These models hold potential as an effective research and educational tool to further investigate damage modes in the lumbar spine structure.

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Abstract ID 68

Interactions between mechanical and immune modulation of human mesenchymal stem cells on micronanotextured Ti-6Al-4V surfaces. ***Elizabeth Byers,[1] Justin L. Brown,[1] Michelle Gallagher,[2] James Sugar.[2]*** **From [1]Pennsylvania State University, University Park, Pa; [2]Medtronic, Memphis, Tenn.**

Background: Nanotextured titanium surfaces have shown improved rates of osteogenic differentiation and integration. These processes involve human mesenchymal stem cells (hMSCs) and resident immune cells, whose behaviours may be controlled via signalling pathways stimulated via cellular interactions with the external environment through force-transmission complexes (FTCs). Mechanosensitive FTCs (e.g., focal adhesions [FAs], adherens junctions [AJs]) help facilitate cellular adaptation to substrate texture and initiate signalling via mechanotransduction. However, FAs and AJs are still poorly understood but likely play roles mediating hMSC impact at the cell–surface interface. FTCs impact cytoskeleton organization, influencing cell shape changes needed for hMSC differentiation to osteoblasts and shifts in protein secretion. To study how surface texture can influence mechanical and immune state, we investigated differences in FTC distribution and cytokine production in hMSCs on titanium alloys with varied topographies. **Methods:** Ti-6Al-4V alloy (Ti), anodized Ti-6Al-4V (AT), Ti-6Al-4V with macro-micro rough (MM) surface and Ti-6Al-4V with macro-micro-nano rough (MMN) surface were seeded with hMSCs in growth media (α-minimum essential medium, 10% fetal bovine serum, 1% penicillin/streptomycin) at 37°C and 5% CO_2. Samples were stained at hours 3 and 24 and day 7 with phalloidin (cytoskeleton), DAPI (nuclei) and antibodies for representative proteins of 3 FTCs or fixed for scanning electron microscopy (SEM). Fluorescence microscopy qualified localization and prevalence. To quantify FTCs, sample lysates were analyzed for cytoskeletal proteins via western blotting. Profiler blots will be used to detect cytokine output at day 7 to investigate the immune response. **Results:** SEM and immunostaining results showed hMSCs adopted spindle-like morphologies on MM, shifting to stellate morphologies on MMN. MMN FA distribution was uniform throughout the cell body, as compared to MM. Nontextured Ti and AT developed flat hMSCs and monolayers by day 7, correlating with more AJ prevalence, which was largely absent on MM and MMN. Cell cortex abundance was consistently higher on AT and MMN. **Conclusion:** Results demonstrate that hMSC morphology and FTC structure are impacted by surface topography. Efforts are currently underway to link mechanical state to cell fate through cyto- and chemokine expression.

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Abstract ID 72

Implementation of workshops in regional British Columbia to enhance clinician confidence in spinal cord injury care provision. ***Shannon Rockall,[1,2] James Hektner,[1,3] Scott Donia,[1] John Chernesky,[1] Vanessa K. Noonan.[1]*** **From the [1]Praxis Spinal Cord Institute, Vancouver, B.C.; [2]Access Community Therapists, Vancouver, B.C.; [3]Accessible Okanagan, Kelowna, B.C.**

Background: In Canada, outside of major urban centres, there is limited knowledge among health care professionals of the complex care needs of people with lived experience (PLEX). This leads to individuals needing to travel long distances to seek specialized clinicians to manage health issues related to spinal cord injury (SCI). To address this, the Praxis Spinal Cord Institute has delivered educational workshops including clinical experts and PLEX to increase knowledge and confidence in various SCI topics for nonspecialized clinicians in regional areas. These education sessions have increased clinician awareness of the unique needs of this population and increased their confidence when working with these individuals. **Methods:** Twenty-three workshops with approximately 40 attendees each were held in Kelowna, Kamloops and Vernon, British Columbia, between February 2022 and July 2023. Workshop topics included SCI 101, pressure injuries, bladder/bowel management, customized/specialized equipment, transfer techniques and PLEX/family panels. Three of the SCI 101 workshops were evaluated before and after the workshop to assess if there was an increase in clinician knowledge and confidence on these topics using a rating scale from 0 (very low) to 5 (very high). **Results:** Clinicians from 3 different workshops (before n = 102, after n = 29) completed the SCI 101 workshop evaluations. According to evidence and PLEX experiences, there was a 12.5% increase in clinician confidence in working with PLEX. Clinicians reported the highest increase in confidence in bladder/bowel management (78.7%), followed by sexual health (68.1%), respiratory health (25.8%) and autonomic dysreflexia (23.2%). Confidence in ability to manage pain and pressure injuries decreased by 27.6% and 16.1%, respectively, as clinicians identified there are gaps in their knowledge. Clinicians appreciated learning from PLEX, understanding secondary complications of SCI, creating contacts and learning about clinical resources. **Conclusion:** These results demonstrate the benefit of SCI knowledge exchange for clinicians working in regional areas, while helping to inform future workshop topics where there are gaps. They highlight the benefit of engaging and sharing lived experience when providing clinical education and establishing connections with clinical experts to enhance SCI care in regional areas.

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Abstract ID 77

Altering physician referral practices is challenging, but not impossible: Spine Assessment Clinic quality-improvement study. ***Aaron A. Varga, Flo Slomp, Emily Thiessen, Nataliya Lastivnyak, Linda Slater Maclean, Vanessa Ritchie, Aaron Hockley*****. From the University of Alberta, Edmonton, Alta.**

Background: Access to medical specialists is a persistent challenge, with neurosurgical spine services reporting some of the longest waits across all fields. Inappropriate and incomplete referrals contribute to delayed access to these providers. Referral guidelines and physician education have been shown to decrease such inefficiencies. Therefore, the goal of this study was to address inappropriate referrals directed to the Royal Alexandra Hospital Spine Assessment Clinic via implementation of a quality-improvement initiative. We hypothesized that appropriate referrals, which included patients with potential surgical pathology who fulfilled referral criteria, would increase by 25% following guideline distribution. **Methods:** A 3-phase study was implemented. First, baseline data were collected from preintervention referrals by noting the reason for consultation and if certain information deemed relevant for an appropriate referral was included. Next, a referral guideline outlining when and how to refer was distributed to family physicians in Northern Alberta. Last, postintervention referrals were collected and analyzed as in phase 1. **Results:** A total of 404 referrals were collected (161 before and 243 after the intervention). A 30% increase in patients who were deemed appropriate surgical candidates was reported after the intervention (p = 0.044), with escalation in the proportion of patients requiring surgical assessment observed over time. Limited improvements were appreciated in the presence of the criteria indicated for inclusion in a referral document. **Conclusion:** While challenges remain when attempting to modify the referring behaviours of primary care physicians, this research has demonstrated that guidelines aimed to enhance specialist referrals can lead to improvements in their performance. Nonetheless, translating guidelines into practice is a recognized issue, often requiring time and multiple exposures. Active forms of medical education and multifaceted interventions have been demonstrated to be the most effective means of implementing guidelines into practice, an approach that could further address Spine Assessment Clinic referral inadequacies in the future.

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Abstract ID 81

Feasibility and outcomes of minimally invasive tubular spinal cord stimulation lead placement: a retrospective case series study. ***Lutz M. Weise, Christine Potvin, Peggy Flynn, Sean Christie*****. From the Neurosurgery Department, Dalhousie University, Halifax, N.S.**

Background: Spinal cord stimulation (SCS) is a surgical intervention for refractory neuropathic pain, traditionally involving an open midline approach, which may result in collateral damage to dorsal midline structures and prolonged recovery. This retrospective study evaluated outcomes and the accuracy of SCS electrode placement using a minimally invasive tubular method and the necessity for procedural adjustments to ensure midline positioning. **Methods:** We reviewed records of 26 consecutive patients (13 males and 13 females) who underwent tubular minimal invasive placement of surgical SCS leads between 2017 and 2023. The majority were diagnosed with failed back surgery syndrome, with other conditions including nonsurgical back and leg pain, multiple sclerosis, spinal injuries and postsurgical pain. The study's primary endpoint was the feasibility of midline electrode placement without resorting to an open approach or a secondary tubular retractor. Furthermore, clinical outcome was measured on a scale of 1 to 5, with 5 representing excellent results. **Results:** Findings showed that 65% of implants were accurately placed around the midline. Around 19% had a slightly oblique positioning, with only 1 case of severe oblique placement. No implants were purely unilateral. Most patients (81%) required only 1 access tube, while 19% needed an additional tube for electrode alignment. No cases necessitated conversion to open surgery. More than half (58%) reported good outcomes, and 23% had excellent improvements after surgery. The remaining 19% saw minimal or no pain relief, with 1 patient having the device removed owing to ineffectiveness.

Complications occurred in 15% of the patients, including 1 with persistent approach-related pain and 3 with stimulation-induced side effects. **Conclusion:** Minimally invasive tubular placement of SCS leads appears to be a feasible and safe technique, achieving satisfactory alignment and clinical outcomes. While current literature on this technique is sparse, comprising mainly retrospective and technical reports, this study contributes valuable insights, warranting further investigation.

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Abstract ID 90

Thermal optimization of robotic piezoelectric osteotomy motion for the purpose of pedicle screw pilot hole preparation. ***Isaac Turkstra*,[1,2] *Bruno Oppermann*,[2] *Marcelo Oppermann*,[1,2] *Shaurya Gupta*,[3,4] *Jibrahn Patel*,[1,2] *Kirill Pustovetov*,[1,2] *Kenneth Lee*,[2] *ChaoLiang Chen*,[1] *Mohammadmahdi Rastgarjazi*,[2] *Victor Yang*.[1,2] From [1]Western University, London, Ont.; the [2]Toronto Metropolitan University, Toronto, Ont.; the [3]University of Toronto, Toronto, Ont.; the [4]London Health Sciences Centre, London, Ont.**

Background: Our lab developed a robotic system capable of predrilling and placing pedicle screws. The system employs an SMTP XD880A piezoelectric osteotome to prepare a pedicle screw pilot hole. However, piezoelectric osteotomes have demonstrated potential to heat bone beyond 47°C, which induces necrosis that could contribute to pseudarthrosis. Thus, we sought to determine the working movements of our system's piezoelectric drill that resulted in the lowest maximum bone temperatures, while ensuring that this optimal drilling motion resulted in temperatures below 47°C. **Methods:** Vertebrae samples were obtained fresh from a local abattoir. Our robot drilled 15-mm holes through the vertebrae bodies parallel to a sectioned viewing surface, which was observed with a FLIR T540 thermal camera. We tested 3 major aspects of the osteotomes movement — the advancement speed, retraction speed and working cycle — to see which combination resulted in the lowest maximum temperatures. Each factor combination was tested 3 times, for a total of 24 trials. **Results:** An advancement speed of 2 mm/s, a retraction speed of 2 mm/s and a novel working cycle termed "multipass" were found to generate the lowest temperatures (41.5 °C, σ = 1.91°C) (Table 1). The factors of retraction speed and working cycle demonstrated statistical significance through analysis of variance. **Conclusion:** Robotic piezoelectric osteotomy appears to represent a safe method of pedicle screw pilot hole preparation from a thermal perspective when using the optimal motion determined in this experiment.

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Abstract ID 98

The need for neuromonitoring during growing rod surgical distractions in early-onset scoliosis. ***Sarah Hardy*,[1,2] *Samuel Strantzas*,[2] *Alison Anthony*,[2] *Jennifer Dermott*,[2] *Mike Vandenberk*,[2] *Samer Hassan*,[2] *David Lebel*.[2,3] From the [1]University of Waterloo, Waterloo, Ont.; the [2]Hospital for Sick Children, Toronto, Ont.; the [3]University of Toronto, Toronto, Ont.**

Background: Intraoperative neurophysiological monitoring (IONM) is common practice in spine surgeries and has been proven to be an accurate and reliable method for early detection of injury to neural structures. Drawbacks, however, may include additional set-up time, financial cost and the need for an alternative anesthetic procedure. Although critical in high-risk procedures, the necessity of IONM in lower-risk procedures, such as growing rod (GR) distractions, is yet to be thoroughly explored. The aim of this study was to investigate the role of IONM during GR distraction surgeries. We hypothesized that it is reasonable to perform distraction surgeries in the absence of IONM. **Methods:** Patients with early-onset scoliosis treated with GR between Feb. 1, 2003, and Mar. 31, 2023, who had IONM were retrospectively reviewed. Surgeries were categorized into primary implant positioning (PIP), distractions, hardware changes and fusion procedures. Descriptive statistics summarized baseline characteristics and surgical details. Neuromonitoring data for all procedures and any record of postoperative neurologic deficits were reviewed. Diagnostic sensitivity and specificity were calculated. **Results:** For the 62 patients included (mean age 6.62 y, 54.8% female), 470 procedures were reviewed, of which 450 had neuromonitoring. Average initial and posttreatment Cobb angles were 83.5° and 60.8°, respectively. Thirteen patients were still undergoing treatment. Procedures included 67 PIPs, 326 distractions, 55 fusions and 2 hardware changes. Thirty-two alerts occurred in 25 procedures: 18 PIPs (26.9%), 3 distractions (0.92%) and 11 fusions (20%). All 3 distraction alerts were positional. Two occurred in the same patient, who had previously had a positional alert during PIP. IONM specificity values were as follows: total 94.4%, PIP 79.1%, distraction 99.1% and fusion 85.5%. Sensitivity was not applicable as no neurological deficits

Table 1. Average temperature observed with various combinations of advancement speed, retraction speed and working cycle of piezoelectric osteotome

Advancement speed, mm/s	Retraction speed, mm/s	Working cycle	Spine 1 temperature, °C	Spine 2 temperature, °C	Spine 3 temperature, °C	Average temperature, °C
1	1	Intermittent	63.0	53.4	52.7	56.4 (σ = 4.70)
2	1	Intermittent	47.8	52.6	48.3	49.6 (σ =2.15)
1	2	Intermittent	48.3	46.5	51.3	48.7 (σ = 1.98)
2	2	Intermittent	45.3	44.8	50.1	46.7 (σ = 2.39)
1	1	Multipass	47.8	41.8	48.1	45.9 (σ = 2.90)
2	1	Multipass	48.6	47.6	48.3	48.2 (σ = 0.42)
1	2	Multipass	42.6	46.6	40.6	43.3 (σ = 2.49)
2	2	Multipass	44.2	40.1	40.2	41.5 (σ = 1.91)

occurred. **Conclusion:** Neuromonitoring alerts were most common during PIP and fusion procedures and occurred during less than 1% of distractions. Given the rare occurrence of IONM alerts during distractions and the lack of neurological injury following these cases, we propose that IONM is not necessary for distraction procedures, especially when patients have not had any distraction-related alerts during PIP.

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Abstract ID 106

Case report: L1 compression fracture in a patient with multilevel lumbar retrosomatic cleft and pedicular dysplasia. ***Yan Gabriel Morais David Silva, Bernard LaRue, Jerome Couture, Newton Pimenta, Jocelyn Blanchard, Alexandre Chenevert, Julien Goulet.*** **From the Université de Sherbrooke, Sherbrooke, Que.**

Background: The aim of the study was to describe a rare case of spinal malformation encompassing multilevel bilateral lumbar retrosomatic cleft and pedicular dysplasia in a patient who presented with a vertebral compression fracture. **Methods:** A 60-year-old female known for controlled systemic scleroderma and hypothyroidism presented with a typical low-energy osteoporotic compression fracture at L1 after lifting a heavy object. She was otherwise healthy and working in a physically demanding environment. She had back pain, and neurological examination was normal. No clinical stigmas of neurofibromatosis (NF) were found. The x-ray showed a typical lumbar compression fracture at L1 and dense thin pedicules at the lumbar levels. A computed tomography scan showed an acute-on-chronic burst fracture of the upper endplate of L1. It showed an overall enlargement of the thoracolumbar spinal canal secondary to multiple bilateral retrosomatic clefts from T12 to L3, within which small asymmetrical round calcifications were found. The patient was treated conservatively without bracing and had a good recovery, returning to her full time job 8 months after the event. **Results:** As Johansen et al. found, clefts may occur in the pedicle, pars or lamina. From what we know, this is the first documented case of multilevel retrosomatic cleft presenting with such diastasis between pedicular margins. Most cases describe a single-level vertical sclerotic cleft at the base of the pedicule. Soleimanpour et al. described a multilevel case in a patient with rheumatoid arthritis without enlarged spinal canal. Although the pedicular dysplasia is similar to the neurofibromatosis radiological stigmas, the absence of clinical history or objective signs suggest a concomitant NF diagnosis in this case. It is important to recognize the condition, and the treatment in any patient with spinal congenital anomalies must be tailored according to a thorough evaluation of clinical, radiological and surgical factors. **Conclusion:** This case highlights the rarity of atypical pedicular malformations with multilevel lumbar retrosomatic cleft and associated pedicular dysplasia. The unique nature of this case emphasizes the potential challenges and considerations in spinal surgery.

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Abstract ID 111

Development of improved patient educational material for elective spine surgery: a patient-engagement initiative. ***Ryan Greene,[1,2] Sean D. Christie,[1] Amanda Hall,[2] Holly Etchegary.[2]*** **From [1]Dalhousie University, Halifax, N.S.; [2]Memorial University, St. John's, N.L.**

Background: Patient education is an important component of the surgical pathway, and, in Enhanced Recovery After Surgery programs, education is a key pillar for these initiatives. Effective educational material is necessary for managing patient expectations, and patients with higher preoperative educational scores have been shown to have improved postoperative mobility, reduced anxiety and reduced pain scores. Educational material should be designed to facilitate patients' being an active participant in their own care, with education being offered to both the patient and their caretaker. This study sought to determine how we can improve the way we provide educational material to patients by taking input from individuals who have experienced surgery before. **Methods:** This study employed a qualitative approach and was a patient-engagement initiative. Interviews were held with patient partners who had a variety of lived experience with surgery (spine, cardiac, and hip and knee replacement). Semistructured interviews were held in groups and during one-on-one sessions. Patients were asked questions surrounding the way they would want educational material to be best delivered, and what barriers and enablers they have experienced in consuming educational material in the past. All interviews were transcribed by 2 reviewers (R.G. and H.E.). **Results:** Five patients participated in the interviews, and 4 methods of delivering education were discussed: online videos, a nursing hotline, audio/visual booklets and classroom sessions. Logistical concerns were present for both the classroom-style sessions as well as nursing hotline. Financial problems were observed with the nursing hotline and patient audio/visual booklets. Issues with access to technology were mentioned for online videos. Patients expressed a desire for personalized education and for incorporating support persons. **Conclusion:** It is difficult to tailor a one-size-fits-all approach for patient education, and some educational interventions are potentially too expensive to be able to reach a broad audience. However, other barriers exist regarding technology and access to the hospital for educational sessions. Multimodal education programs could be a good compromise to engage patients.

P-154
Abstract ID 114

The natural history of spinal cord cavernous malformation: a systematic review and meta-analysis. ***Alwalaa Althagafi, Jae Han, Ryan Greene, Sean Christie, Gwynedd Pickett.*** **From the Division of Neurosurgery, Dalhousie University, Halifax, N.S.**

Background: Cavernous malformations (CMs) are angiographically occult vascular lesions with clusters of dilated sinusoidal channels lined by a single endothelium layer with no intervening neural parenchyma. Their reported prevalence ranges from 0.4% to 0.6% among the general population. These lesions can be found incidentally or with symptoms caused by hemorrhage and/or enlargement. Spinal cord CMs are a rare type of central nervous system CMs. The literature studying their natural history has been lacking. Our objective

was to evaluate the body of literature describing the natural history of CMs and perform a meta-analysis, if feasible, to assess the natural history of spinal cord CMs and contrast it against that of intracranial CMs. **Methods:** We searched MEDLINE, Embase and ISI Web of Science databases using comprehensive terminology for literature on CMs. Additionally, Scopus software was used for snowball searching, and previous systematic reviews/meta-analyses were used to locate all studies included in them to cross-reference our primary search. **Results:** Among 3538 papers screened, we identified 7 cohorts meeting our criteria, including 280 patients with a follow-up duration of 1293.4 patient-years. These cohorts' reported annual hemorrhage rates ranged from 1.7% to 10%. Only 21 patients (7.5%) were asymptomatic and incidentally diagnosed at the time of diagnosis. We will conduct the meta-analysis using a random-effects model and attempt to calculate the incidence of events (hemorrhagic and nonhemorrhagic) according to the anatomical location and the hemorrhagic status (prior bleed v. no bleed). We will also assess independent risk factors for hemorrhage and loss of neurological function. **Conclusion:** Our study highlights the limited amount of good-quality studies describing the natural history of spinal CMs. There is significant heterogeneity in reporting spinal cord CM cases and their outcomes. We suggest developing a national registry for spinal cord CMs with a standard follow-up and outcome-reporting protocol. The results of our meta-analysis will be finalized and presented at the conference.

P-155
Abstract ID 124

The influence of obesity on spinal nonunion: a systematic review and meta-analysis. ***Christopher Witiw,[1] James Harrop,[2] W. Bradley Jacobs,[3] Gonzalo Mariscal,[4] Ahmed Essa.[1]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]Departments of Neurological and Orthopedic Surgery, Thomas Jefferson University, Philadelphia, Pa.; the [3]Calgary Spine Program and Division of Neurosurgery, Cumming School of Medicine, University of Calgary, Calgary, Alta.; the [4]Mediterranean Observatory for Clinical and Health Research, Valencia, Spain.**

Background: Obesity (body mass index [BMI] ≥ 30) rates continue to rise globally. Their relationship to spinal surgery outcomes and health care costs is poorly defined. Individual studies have reported inconsistent results. This study aimed to assess the association between obesity and the incidence of nonunion after spinal fusion surgery. **Methods:** A systematic search was conducted following PRISMA guidelines across PubMed, Embase, Scopus and the Cochrane Library. Studies comparing BMI or obesity (BMI ≥ 30) versus nonobesity (BMI < 25) in patients undergoing spinal fusion surgeries were included. The primary outcome of interest was the incidence of spinal nonunion. Meta-analysis was performed using Cochrane RevMan software, with random effects applied in the presence of heterogeneity. **Results:** Of the 538 screened studies, 15 studies comprising 269 640 patients met the inclusion criteria and were included in the meta-analysis. Mean BMI had no significant differences related to nonunion for cervical (mean difference [MD] –0.13, 95% confidence interval [CI] –0.57 to 0.32, $p = 0.58$) or lumbar (MD –0.62, 95% CI –2.10 to 0.87, $p = 0.41$) levels. In univariate analysis, for each unit increase in BMI, the risk of developing nonunion increased by 10% compared to those with lower BMI (odds ratio [OR] 1.10, 95% CI 1.06 to 1.14, $p < 0.00001$). Multivariate analyses did not show significant differences (OR 1.05, 95% CI 0.98 to 1.12, $p = 0.14$). However, sensitivity analyses showed a significant 12% increase in the risk of nonunion per BMI unit at the lumbar level (OR 1.12, 95% CI 1.03 to 1.21, $p = 0.007$). Obesity exhibited a statistically significant association with a twofold increased likelihood of nonunion (OR 2.10, 95% CI 1.23 to 3.60, $p = 0.007$). Sensitivity analysis showed a further increase in this association (OR 4.58, 95% CI 2.09 to 10.03, $p = 0.0001$). **Conclusion:** This meta-analysis suggests that a greater BMI and obesity are associated with an increased risk of spinal nonunion. These findings highlight the importance of addressing prevalent and modifiable risk factors such as obesity to improve patient outcomes in spine fusion surgeries.

P-156
Abstract ID 126

Meta-analysis of the effects of diabetes mellitus on fusion rates and patient-related outcomes in spinal fusion surgery. ***W. Bradley Jacobs,[1] Gonzalo Mariscal,[2] Christopher Witiw,[3] James S. Harrop,[4] Ahmed Essa.[3]*** **From the [1]Calgary Spine Program and Division of Neurosurgery, Cumming School of Medicine, University of Calgary, Calgary, Alta.; the [2]Mediterranean Observatory for Clinical and Health Research, Valencia, Spain; the [3]University of Toronto, Toronto, Ont.; the [4]Departments of Neurological and Orthopedic Surgery, Thomas Jefferson University, Philadelphia, Pa.**

Background: Diabetes mellitus (DM) is believed to be associated with an increased risk of adverse events during spinal surgery. With the increasing prevalence of DM and the increasing number of degenerative spinal procedures, understanding postsurgical expectations and optimal care is essential. This meta-analysis aimed to provide a comprehensive evaluation of the impact of DM on spinal surgery outcomes, specifically assessing fusion rates and patient-reported outcome measures (PROMs). **Methods:** Following the PRISMA guidelines, we conducted a systematic search across PubMed, Embase, Scopus and the Cochrane Library, selecting studies comparing patients with and without DM who underwent spine fusion surgeries. Outcomes of interest were the incidence of spinal pseudarthrosis and PROMs. Odds ratios (ORs) were calculated for dichotomous variables, whereas mean differences (MDs) were calculated for continuous variables. Standard mean differences (SMDs) were used for continuous variables that did not share the same scale or units. Meta-analysis was performed using Cochrane's RevMan version 5.4 software. Random effects were used if there was evidence of heterogeneity. **Results:** Eighteen studies comprising 118 617 patients were included in the final analysis. Patients with DM had a higher incidence of pseudarthrosis at the lumbar spine (OR 1.13, 95% confidence interval [CI] 1.02 to 1.25, $p < 0.05$). Patients with DM also reported increased Visual Analogue Scale back/neck pain scores (SMD

0.21, 95% CI 0.14 to 0.28, $p < 0.001$) and worse Oswestry Disability Index (MD 3.96, 95% CI 3.10 to 4.82, $p < 0.001$), EuroQol-5D (EQ-5D) (MD –0.06, 95% CI –0.08 to –0.03, $p < 0.001$) and 12-Item Short Form Survey (SF-12) Physical Component Summary (SMD –2.70, 95% CI –4.99 to –0.41, $p < 0.05$) scores. **Conclusion:** Patients with DM who underwent spinal surgery had a higher incidence of pseudarthrosis and worse functional outcomes compared to patients without DM. These findings underscore the need for targeted clinical management and preventive strategies for patients with DM undergoing these procedures.

P-158
Abstract ID 91

Cost savings analysis through a direct-to-hospital sales model for interbody cages. ***Timothy Lasswell,[1] Parham Rasoulinejad,[2] Richard Hu,[1] Chris Bailey,[2] Fawaz Siddiqi.[2]*** **From the [1]University of Calgary, Calgary, Alta.; [2]Western University, London, Ont.**

Background: The Canadian health care system is striving to improve the cost-efficiency of medical procedures and devices, with spine surgery being no exception. This project aimed to investigate the potential for cost savings by introducing a direct-to-hospital sales model for interbody cages. **Methods:** Medical device sales involve intermediaries, including manufacturers, distributors and sales representatives, which contribute to the overall device cost. By bypassing some of these intermediaries and implementing a direct sales approach to hospitals, cost savings can be achieved while maintaining the quality of care. This project will utilize a cost analysis to identify the potential areas for cost reduction in the current distribution model. Additionally, it will investigate the feasibility of implementing a direct-to-hospital sales model, addressing regulatory and logistical challenges. Case studies and surveys with key stakeholders, including hospitals, surgeons and medical device manufacturers, will be conducted to assess the impact of this model on the procurement process, pricing and overall cost-efficiency of interbody cages. **Results:** Initial feasibility analysis at a single Canadian spine centre has revealed that a direct-to-hospital sales model for cages is possible with a Canadian medical device manufacturer using a titanium 3D-printing process. Further analysis revealed that posterior lumbar interbody fusion and transforaminal lumbar interbody fusion cages represent the largest opportunity for savings, with a potential cost reduction of 50% compared to the current distribution model. For this centre, this would result in an annual savings of $175 000. Design of the cage has been completed and reviewed with Health Canada to confirm the requirements for regulatory approval. Logistics concerns such as packaging and sterilization have also been discussed. **Conclusion:** Preliminary results obtained at a single Canadian centre conclude that a direct-to-hospital sales model for cages has the potential for significant cost savings. Future work includes obtaining device regulatory approval and onboarding additional Canadian spine centres to maximize savings nationally. While regulatory and logistical challenges still need to be addressed, the benefits of cost savings while maintaining quality care make a direct-to-hospital model promising for the Canadian health care system.

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Abstract ID 158

A survey comparing postsurgical opioid prescribing practices of neurosurgeons around the world following lumbar discectomies and craniotomies. ***Abdulrahman Hamdoon,[1] Mohamed Amin Soliman,[2] Jubi Maraj,[3] Deven Jhawar,[4] Balraj Jhawar.[1]*** **From the [1]Schulich School of Medicine and Dentistry, Western University, Windsor, Ont.; the [2]University of Buffalo, Buffalo, N.Y.; the [3]University of Windsor, Windsor, Ont.; [4]Western University, London, Ont.**

Background: The opioid crisis has reached epidemic proportions in North America. Recent studies suggest that opioids are more likely to be prescribed following surgery in North America than in other regions. Our goal was to compare the prescribing practices of neurosurgeons around the world following 2 common procedures: lumbar discectomy and craniotomy. Also, we wished to explore factors that may influence neurosurgeons to prescribe opioids. We hypothesized that North American neurosurgeons may be prescribing opioids more frequently and for longer durations than their counterparts in other regions. **Methods:** Neurosurgeons from around the world will be recruited from academic centres and professional organizations. Participants will be asked to complete an online questionnaire regarding their postoperative prescribing practices and factors involved in their decision-making process. These factors include practice experience, type and duration of analgesia, and regulations and processes used to prescribe. Appropriate statistical methods will be used to analyze the relationship between these factors and the region of practice. **Results:** We have developed a 20-item questionnaire that asks questions regarding opioid prescribing practices and factors that influence these decisions. **Conclusion:** We anticipate significant regional differences among neurosurgeons regarding their postoperative analgesia prescribing patterns. We believe this may be due to certain cultural norms for pain management in various regions. We hope to explore factors that may be influencing these decisions. We hope this paper will foster a discussion among neurosurgeons about opioid use following surgery and what should be considered reasonable durations of treatment.

P-160
Abstract ID 45

Performance comparison between Hounsfield units and dual-energy x-ray absorptiometry in predicting lumbar interbody cage subsidence after circumferential lumbar fusion. ***Kirsten A. Schuler,[1] Lindsay D. Orosz,[2] Tarek Yamout,[2] Brandon J. Allen,[1] Wondwossen T. Lerebo,[1] Rita T. Roy,[1] Thomas C. Schuler,[2] Christopher R. Good,[2] Colin M. Haines,[2] Ehsan Jazini.[2]*** **From the [1]National Spine Health Foundation, Reston, Va.; the [2]Virginia Spine Institute, Reston, Va.**

Background: Bone mineral density assessment is essential for spinal fusion surgical planning, but gold standard dual-energy x-ray absorptiometry (DEXA) is affected by degeneration, often resulting in falsely elevated scores. Studies on opportunistic measurement of computed tomography Hounsfield units (CTHUs) suggest lower values predict interbody cage

subsidence, yet cut-off values vary and lack standardization. This study aimed to determine if CTHU cut-off value < 135 is associated with lumbar interbody cage subsidence and to compare the predictive performance of subsidence between CTHU and DEXA. **Methods:** Circumferential lumbar fusions were retrospectively enrolled if DEXA and CT images and x-rays were available. Interbody fusions were analyzed for subsidence ≥ 2 mm by validated motion detection software. Lowest DEXAany and DEXAspine T-scores were categorized (normal ≥ –1.0, –1.0 > osteopenia > –2.5, osteoporosis ≤ –2.5), and L1 CTHUs were measured. Analysis determined the association between CTHU < 135 and subsidence. Univariate and multivariate binary logistic regression compared the predictive performance of subsidence between CTHU and DEXA. **Results:** The 127-patient cohort had 96.9% degenerative pathologies, 54.3% females, median age 60 years, 2.4% osteoporosis, 44.1% CTHU < 135 and 13.4% subsidence. CTHU < 135 (p = 0.004) and age (p = 0.016) were significantly associated with subsidence; DEXA lowest T-score was not (p = 0.550). The odds of subsidence were statistically significant if CTHU < 135 for crude and adjusted (odds ratio [OR] 4.0, 95% confidence interval [CI] 1.2–13.9, p = 0.029) comparisons. The odds of subsidence were not significant if lowest T-score < –1.0 for DEXAany and DEXAspine (OR 1.8, 95% CI 0.6–4.9, p = 0.284, and OR 1.1, 95% CI 0.3–4.1, p = 0.920, respectively). **Conclusion:** CTHU < 135 was associated with subsidence, while DEXA lowest T-score was not, in patients with degenerative pathologies. The odds of subsidence were 4.0 times higher for CTHU < 135 after known risks were controlled for, supporting this cut-off value. This study suggests that CTHU is a more reliable predictor of subsidence than DEXA and is a useful tool for assessing bone quality when planning lumbar surgery.

P-67
Abstract ID 73

Can classical machine-learning models predict long-term degenerative cervical myelopathy outcomes? ***Kalum J. Ost,[1] Abdul Al-Shawwa,[1] David Anderson,[2,3] Nathan Evaniew,[4,5] Bradley W. Jacobs,[4,6] Peter Lewkonia,[4,5] Fred Nicholls,[4,5] Paul T. Salo,[4,5] Kenneth C. Thomas,[4,5] Michael Yang,[1] David Cadotte.[1,2,4,6]*** **From the [1]Hotchkiss Brain Institute, University of Calgary, Calgary, Alta.; the [2]Department of Biochemistry and Molecular Biology, University of Calgary, Calgary, Alta.; the [3]Alberta Children's Hospital, Calgary, Alta.; the [4]Combined Orthopaedic and Neurosurgery Spine Program, University of Calgary, Calgary, Alta.; the [5]Section of Orthopaedic Surgery, University of Calgary, Calgary, Alta.; the [6]Department of Clinical Neurosciences, Cumming School of Medicine, Calgary, Alta.**

Background: Degenerative cervical myelopathy is the most common form of spinal cord injury in Canada. Despite its severe impact on patient quality of life, the prognosis of a patient is difficult to predict owing to its complexity, with only 50%–70% of patients improving after diagnosis and surgical treatment. We aimed to evaluate whether modern machine-learning analyses can predict long-term patient outcomes, finding any model(s) which could identify patients who are most likely to improve from treatment. **Methods:** Using demographic (age and sex), clinically derived (quality-of-life assessments) and magnetic resonance imaging (MRI)–derived metrics sequences from 345 patients, we evaluated numerous machine-learning algorithms, including logistic regression, support vector machines, random forests and k-nearest neighbor. For MRI-derived metrics, models could be given access to the outputs of 1 or 2 segmentation algorithms, PropSeg or DeepSeg. Using parameterized 10-fold cross-validated grid search, we identified the model that best predicted a patient's postoperative outcomes. Each of these were also run with 10 times, with 10% of the data being held out each time for validation, to avoid any model appearing to outperform the others by random chance. **Results:** Compared to the baseline "performance" of clinicians at predicting patient outcomes (around 50% balanced accuracy), machine-learning models performed only marginally better, reaching a peak balanced accuracy of 67% using a logistic regression model trained on image-derived metrics from T_2-weighted axial MRI sequences. However, the best performing models utilized MRI-derived metrics from the least accurate of the 2 segmentation algorithms; on inspection, this appeared to be because this algorithm failed in regions of spinal cord compression, "emphasizing" their presence to the model. **Conclusion:** While the models we tested in this study are insufficient for clinical application, the best-performing models relying on emphasized regions of compression will help inform the design of future models. Therefore, models trained to identify these regions accurately (though new image segmentation algorithms or deep-learning models) are likely the best approach to improve model performance.

P-68
Abstract ID 131

The relative importance of cervical myelopathy treatment outcomes to spine surgeons and family physicians in Canada: a discrete-choice experiment. ***Mohamed Sarraj,[1] Nathasha Rajapaksege,[1] Nicolas Dea,[2] Nathan Evaniew,[3] Greg McIntosh,[4] Markian Pahuta,[1] the CSORN Investigators.[4]*** **From [1]McMaster University, Hamilton, Ont.; the [2]University of British Columbia, Vancouver, B.C.; the [3]University of Calgary, Calgary, Alta.; [4]Canadian Spine Outcomes and Research Network, Toronto, Ont.**

Background: The goal of this study was to quantify and compare the relative importance of neurologic function, risk of future surgery and complications to physicians caring for patients with cervical stenosis. Degenerative cervical myelopathy is a debilitating condition, and current recommendations encourage shared decision-making between surgeons and patients. However, there are limited data on physicians' values and preferences for surgical decision-making. **Methods:** Using snowball sampling, we recruited spinal surgeons and family physicians from across Canada. Demographic and practice information was collected. Participants then completed an online discrete-choice experiment survey. In a series of 10 questions, respondents chose between 2 hypothetical health states defined in terms of 5 attributes or "decision factors": 1) upper extremity neurologic function, 2) lower extremity neurologic function, 3) risk of cervical spine surgery, 4) dysphagia and 5) C5 palsy. Participants were asked to choose which "life" they preferred, and a regression model was used to quantify the importance of

each decision factor. **Results:** Seventy family physicians and 70 spinal surgeons participated in this study. For family doctors, the rank order of decision factor importance was upper extremity neurologic function > lower extremity neurologic function > dysphagia > risk of revision surgery > C5 palsy. For spinal surgeons, upper and lower extremity neurologic function were equally important and weighed more highly than dysphagia. Notably, C5 palsy and risk of revision surgery were not considered important decision factors by spinal surgeons. **Conclusion:** Both generalist family physicians and specialist spine surgeons highly value neurologic function. However, the negative impacts of surgery are less important to spinal surgeons than to family doctors. When compared to previously reported work, family physicians' values were congruent with values of patients with cervical stenosis. These findings highlight the need for surgeons to be cognizant of the fact that their values may differ from those of their patients when engaging in shared decision-making.

P-69
Abstract ID 133

Effect of elective cervical spine surgery on mental health of patients with degenerative cervical myelopathy: a CSORN study. ***Hani Nouran Alharbi,[1,2] Khaled Skaik,[1,3] Eugene K. Wai,[1,2] Stephen Kingwell,[1,2] Alexandra Stratton,[1,2] Eve Tsai,[1,2] Philippe Tran Nhut Phan,[1,2] Zhi Wang,[4] CSORN Investigators.[5]*** **From the [1]Ottawa Hospital, Civic Campus, Ottawa, Ont.; the [2]University of Ottawa, Ottawa, Ont.; [3]McGill University, Montréal, Que.; [4]Centre hospitalier de l'Université de Montréal, Montréal, Que.; the [5]Canadian Spine Society, Markdale, Ont.**

Background: The objective of this investigation was to evaluate whether enhancements in health-related quality of life (HRQOL) consequent to efficacious cervical spine surgery in individuals diagnosed with degenerative cervical myelopathy (DCM) lead to improvements in mental health metrics. **Methods:** The primary outcome assessed was the change between the preoperative and postoperative 12-Item Short Form Survey (SF-12) Mental Component Summary (MCS) score, alongside the modified Japanese Orthopaedic Association (mJOA) score. Secondary outcomes included the SF-12 Physical Component Summary (PCS), EuroQol-5D (EQ-5D), Neck Disability Index (NDI), Patient Health Questionnaire-9 (PHQ-9) and neck pain scale scores. The Canadian Spine Outcomes and Research Network (CSORN) registry was queried for all patients who received surgery for DCM with ≥ 12 months of follow-up. Exclusion criteria were trauma, tumour, infection and previous spine surgery. Patients were categorized into 6 distinct cohorts based on their SF-12 MCS score (preoperative presence or absence of depression) and mJOA score (mild, moderate or severe DCM). SF-12 MCS scores were compared between those with and without significant improvement (reaching minimally clinically important differences [MCIDs]) for mJOA score and between disease severity groups. Multivariate analysis examined factors predictive of MCS improvement. **Results:** Twenty-two hospitals contributed 500 eligible patients. There was a greater significant improvement in MCS and NDI scores 12 months postoperatively across all cohorts in the depressed cohort compared to their respective nondepressed cohorts. Patients exceeding MCID in mJOA score had the greatest improvements in MCS regardless of disease severity. Major depression prevalence decreased by 43% following the DCM surgery. Of all the factors studied, only the presence of depression preoperatively was predictive of improved MCS score postoperatively, with an odds ratio of 4. **Conclusion:** Our data suggest that successful surgery for DCM is associated with improvement of MCS score and decrease in prevalence of major depression; this decrease was more pronounced in patients with preoperative depression regardless of the severity of DCM.

P-70
Abstract ID 143

Using smartphones for clinical assessment in cervical spondylotic myelopathy: a small cohort study. ***Julien Francisco Zaldivar-Jolissaint.*** **From the University of British Columbia, Vancouver, B.C.**

Background: Degenerative cervical myelopathy (DCM) is characterized by progressive deterioration in spinal cord function. Its evaluation requires subjective clinical examination, with wide interobserver variability. Objective quantification of spinal cord function remains imprecise, even though validated myelopathy-grading scales have emerged and are now widely used. A smartphone app, the N-Outcome App, was created with the aim of quantifying spinal cord dysfunction accurately and reliably using a 5-minute test. **Methods:** Five patients with DCM were clinically evaluated before surgery and at 3 and 6 months after surgical decompression of the cervical spinal cord. Standard scores (Nurick grade, modified Japanese Orthopaedic Association [mJOA] score) were documented at these time points. A 5-minute motor and proprioceptive performance test aided by a smartphone with the N-Outcome App was also performed. **Results:** All patients presented improvements in motor performance in rapid alternating movements and finger tapping in correlation with improvements in standard grading scale scores. Clinical improvements were seen in maximum reflex acceleration and in Romberg testing, which showed less closed/open eyes variation, suggesting pyramidal and proprioceptive function recovery. **Conclusion:** The results demonstrate that using the N-Outcome App as an adjunct to clinical evaluation of compressive myelopathy is feasible and potentially useful. The results correlate with the results of clinical assessment obtained by standard validated myelopathy scores.

P-71
Abstract ID 151

Cervicothoracic construct fixation comparison using finite-element analysis. ***Sara Gustafson,[1] Ian Polyzois,[1] Trevor Gascoyne,[1] Michael Goytan.[2,3]*** **From the [1]Orthopaedic Innovation Centre, Winnipeg, Man.; the [2]Section of Orthopaedic Surgery, Department of Surgery, University of Manitoba, Winnipeg, Man.; the [3]Winnipeg Spine Program, Winnipeg, Man.**

Background: Spinal fixation hardware and construct assembly can vary between cases. In standard posterior cervicothoracic constructs for spinal fusion, lateral mass and pedicle screws are

connected to rods that extend from the subaxial spine to T1 or T2. Common modes of failure for these constructs are screw pullout and mechanical failure of the rods or screws. Deciding what construct configuration would present the lowest risk of failure and best clinical outcome can be challenging. We investigated the mechanical performance of different variations of a posterior spine construct in a C5–C6 to T1–T2 cervicothoracic vertebrectomy model using finite-element analysis (FEA). The main objectives were to identify the modes of failure, and worst-case and best-case configurations to support successful cervicothoracic fusion. **Methods:** Eight configurations were simulated using FEA under worst-case scenario loading. Simplified models were created that followed ASTM F1717 and ISO 12189. The effects of adding splint rods, increasing screw and rod diameters, and changing the rod material were evaluated. Maximum load-bearing capacity, displacement at yielding, construct stiffness, and maximum stresses in the rods and screws were measured. **Results:** The best-case and worst-case configurations showed load-bearing capacities of 107 N and 66 N, respectively. Primary and secondary modes of failure in all configurations were identified as screw loosening and rod notching at T1, respectively. Adding splint rods improved the load-bearing capacity of the construct. Changing the rod material from titanium to cobalt alloy improved the load-bearing capacity for a 2-rod design. Increasing the rod and screw diameter increased construct stiffness but decreased the load-bearing capacity, which led to early screw loosening. **Conclusion:** Through simulation loading on various cervicothoracic spinal constructs, we found that adding splint rods to increase construct stiffness improved fixation. However, certain constructs may be too stiff and have a detrimental effect, leading to premature failure on the screw fixation. The findings show the importance of correlating construct stiffness with patient condition when deciding which configuration will produce optimal performance, fixation and clinical outcome.

P-72
Abstract ID 152

Posterior cord syndrome: a possible indication for clinical failure in anterior cervical discectomy and fusion for cervical spondylotic myelopathy, and denial of equipoise. ***Drew Alexander Bednar*, *Mohamed Sarra*. From McMaster University, Hamilton, Ont.**

Background: The objective was to present posterior cord syndrome (PCS) in cervical spondylotic myelopathy (CSM) as a risk factor for clinical failure of anterior cervical discectomy and fusion (ACDF) surgery. The frequency of PCS in CSM is unknown as the clinical signs may be subtle and are not widely reported. Current surgical literature concludes equipoise in approach for decompression of CSM in the well-aligned neck. Recent publications suggest anterior surgery may not bring clinical benefit in cases in which posterior compression deforming the spinal cord is evident. **Methods:** Our centre recently treated 2 patients with CSM whose limb numbness and gait instability were the major complaints, but motor strength was preserved. In both cases, posterior cord signs were evident preoperatively, and ACDF brought no immediate benefit. **Results:** Both cases responded well to subsequent posterior decompression. **Conclusion:** The patient with CSM with unstable gait and preserved motor strength should be examined clinically for posterior cord signs and the magnetic resonance imaging examination reviewed for significant posterior compression. These factors may argue against equipoise in treating this condition.

P-74
Abstract ID 17

One-third of adult surgical patients with spinal deformity are consuming opioids both pre- and postoperatively, with significant international differences: this is partly a cultural issue. ***Brett Rocos*,[1] *Juan P. Sardi*,[2] *Anastasios Charalampidis*,[3] *Jeff Gum*,[4] *Stephen J. Lewis*.[5] From [1]Duke University Hospital, Durham, N.C.; the [2]University of Virginia, Charlottesville, Va.; the [3]Karolinska Institute, Stockholm, Sweden; [4]Norton Healthcare, Louisville, Ky.; the [5]Toronto Western Hospital, Toronto, Ont.**

Background: It is important for providers to understand variables that contribute to sustained opioid use after adult spinal deformity (ASD) surgery. Propaganda has pushed a cultural perception demanding opioids, which likely has some influence on opioid use. Our goal was to evaluate if there are international differences with regards to pre- and postoperative opioid consumption surrounding ASD surgery. **Methods:** Patients ≥ 60 years of age from 12 international centres undergoing spinal fusion of ≥ 5 levels with at least 2 years of follow-up were included. Pain scores were collected using a Numeric Rating Scale for back (NRS-B) and leg (NRS-L) pain. Opioid use was defined as using opioids based on prescriptions and question 11 from the Scoliosis Research Society-22r (SRS-22r) questionnaire at baseline and 2 years. Centres were divided into North American, European and Asian. **Results:** A total of 219 patients ≥ 60 years of age (176 females [80.4%], mean age 67.5 yr) from 12 international centres who underwent ≥ 5-level spinal fusion for ASD had baseline opioid data, with 179 patients supplying data at 2 years. Overall, a similar number of patients reported opioid use preoperatively and at 2 years postoperatively (75/219 [34%] v. 55/179 [31%]). Only 5.8% and 7.7% of Asian patients were taking opioids pre- and postoperatively, respectively, with corresponding numbers being 58.3% and 53.2% for European patients, and 50.5% and 40.2% for North American patients. There was no difference in NRS-B or NRS-L scores for European patients at baseline or 2 years regardless of opioid use. Patients consuming opioids at baseline showed worse mean NRS-L scores (7.6 v. 4.2, $p = -0.023$); otherwise, there was no difference in baseline NRS-B or 2-year NRS-B or NRS-L scores. North American patients using opioids had worse mean baseline NRS-B score (6.6 v. 5.5, $p = -0.003$) and 2-year NRS-B (3.3 v. 1.4, $p = -0.001$) and NRS-L (2.6 vs. 1.0, $p = -0.007$) scores. **Conclusion:** Almost one-third of patients undergoing ASD surgery are consuming opioids both pre- and postoperatively worldwide. There is a drastic international difference, with Asia having a much lower usage rate, suggesting a cultural influence.

P-75
Abstract ID 32

Baseline blood pressure influences frequency of neuromonitoring alerts during posterior fusion for adolescent idiopathic scoliosis. ***Ravi Ghag, Samuel Kirk, Otis Shirley, Jeffrey Bone, Andrew Morrison, Firoz Miyanji.* From the BC Children's Hospital, Vancouver, B.C.**

Background: The objective was to conduct a retrospective study on the influence of baseline mean arterial pressure (MAP) on the frequency of intraoperative neuromonitoring (IONM) alerts in adolescent idiopathic scoliosis surgery. **Methods:** A retrospective case series study of posterior spinal instrumentation and fusion procedures performed in patients with adolescent idiopathic scoliosis by a single surgeon at 1 institution between 2016 and 2020 was undertaken. Data collected included surgical time, Lenke classification, number of instrumented levels, estimated blood loss, surgical complications, number of IONM alerts, MAP at admission and MAP at time of setting IONM baselines. Cases were stratified by operations with no IONM alerts, 1–2 alerts and ≥ 3 alerts. Descriptive statistics and ordinal logistic regression analysis were performed using R statistical software. **Results:** Seventy-six patients were included, with a median age of 15 years; 80.3% of subjects were female. Patients in the high-alert group had a longer surgical time, higher estimated blood loss and a larger preoperative major curve Cobb angle. After adjustment for these confounders, a 5-mm Hg increase in MAP at baseline resulted in an adjusted odds ratio of being in a higher-alert group of 1.29 (95% confidence interval 1.03–1.66). **Conclusion:** An association between a higher MAP at time of IONM baseline setting and an increased number of IONM alerts was observed. Previous studies have demonstrated resolution of IONM alerts by increasing MAP in the setting of presumed spinal cord hypoperfusion. This is the first study to directly analyze the effect of MAP at time of setting IONM baselines on the frequency of alerts. The findings suggest a complex interplay between MAP and IONM alerts during adolescent idiopathic scoliosis surgery.

P-77
Abstract ID 59

Effects of teriparatide on complications, surgical outcomes and health-related quality of life in osteoporotic patients undergoing correction of adult spinal deformity. ***Amit Parekh, Ethan Sanders, Manjot Birk,Fred Nicholls.* From the University of Calgary, Calgary, Alta.**

Background: Mechanical complications, such as proximal junctional failure (PJF) and implant failure, are common sequelae in the surgical management of adult spinal deformity (ASD). Previous studies have demonstrated superior efficacy of teriparatide in comparison to other osteoporosis treatments in ability to improve bone density and better restore or retain native bone architecture. There is evidence that, for patients with ASD undergoing surgery, teriparatide may reduce PJF rates and improve fusion rates. To date, no study has examined the rates of mechanical complications and clinical outcomes in osteoporotic patients with ASD treated with teriparatide. Furthermore, the specific indications and treatment guidelines for teriparatide in this setting are not defined, and, although teriparatide is Health Canada–approved for the treatment of osteoporosis, it is not covered by most provincial formularies for deformity correction. The aim of this study was to evaluate the effects of teriparatide on complications and clinical outcomes in patients undergoing surgical correction of ASD, and to identify patient and/or surgical factors to guide future indications and treatment. **Methods:** Retrospective chart reviews of patients enrolled in the Canadian Spine Outcomes and Research Network (CSORN) database who received treatment with teriparatide prior to and/or after surgical correction of ASD were completed, with data recorded on bone density obtained from computed tomography and/or dual-energy x-ray absorptiometry (DEXA) imaging preoperatively and postoperatively. A total of 35 patients were identified. Patient demographics, relevant history as related to deformity outcomes, surgical data, radiographic alignment parameters, surgical outcomes, complications and clinical outcomes were recorded. Propensity matching will be utilized to create a control group from the same database, with number of patients available to draw from. The data will be evaluated using various statistical methods to determine potential differences between treatment groups as well as to determine specific circumstances in which teriparatide use may lead to favourable results. **Results:** Results for this study are pending. **Conclusion:** Conclusions for this study are pending.

P-78
Abstract ID 71

Postoperative day 1 discharge for patients undergoing vertebral body tethering; optimization of a rapid discharge protocol. ***Kevin Smit, Holly Livock, Jessica Romeo, James Jarvis, Andrew Tice.* From the Children's Hospital of Eastern Ontario, Ottawa, Ont.**

Background: Thoracoscopic vertebral body tethering (VBT) is a minimally invasive surgical technique that helps modulate spinal growth, allowing for scoliosis correction. It has been associated with less pain, fewer narcotic requirements, early mobilization, decreased blood loss and shorter length of stay compared to posterior spinal instrumentation and fusion (PSF). The objective of this study was to determine if it is feasible to achieve postoperative day 1 discharge following VBT surgery following the optimization of a rapid-discharge protocol. **Methods:** A retrospective review of consecutive VBT surgeries performed at a single institution since January 2018 was carried out. Optimizations of a rapid-discharge protocol have been made to allow early mobilization, timely removal of the chest tube, use of intercostal blocks and minimization of opioid use. Patient demographics, surgery length, estimated blood loss, anesthetic type, postoperative analgesia, duration of chest tube placement, mobilization and length of stay were recorded. Postoperative complications, unplanned return to the operating room and unplanned visits at 30 days were documented. **Results:** Forty-nine patients (average age 12.0 yr, 90% female, average body mass index 19.0 and average preoperative Cobb angle 53°) underwent thoracic VBT surgery. The average surgical time was 221 minutes, and the mean estimated blood loss was 278 mL. Postoperative Cobb angle correction was 55% on first erect standing radiograph. Length of stay gradually decreased over a 4-year period. Four patients were successfully discharged on postoperative day 1. These patients all received intercostal blocks and were

mobilized on the evening of surgery, and the chest tube was removed within 18 hours of surgery. No patients had unplanned return to the operating room or the emergency department in the first 30 days. Postoperative adverse events included small pleural effusions and subcutaneous emphysema, none of which required interventions. **Conclusion:** The utilization of an optimized rapid-discharge pathway enables safe postoperative day 1 discharge from hospital following VBT surgery without unplanned return to the operating room or the emergency department.

P-79
Abstract ID 79

Characterization of spinopelvic parameters in children under 10 years of age with spondylolisthesis and analysis of progression. ***Sofía Frank, Hubert Labelle, Stephan Parent, Soraya Barchi, Julie Joncas, Jean-Marc Mac-Thiong.* From the Université de Montréal, Montréal, Que.**

Background: The objective was to characterize the sagittal spinopelvic balance in the pediatric population with spondylolisthesis and to evaluate the correlations between spinopelvic parameters. **Methods:** Spinopelvic parameters and sociodemographic variables were evaluated in children less than 10 years old with spondylolisthesis. **Results:** We analyzed 94 patients, 58 girls and 36 boys. Of the 94, 64 had grade 1 spondylolisthesis, 26 grade 2 and 4 grade 3; no child had grade 4. The average age at the first visit was 8.5 years, while the average at the last visit was 13.7 years. The mean pelvic incidence, pelvic tilt and sacral slope at the first visit were 49.2°, 8.8° and 40.1°, respectively, while at the last visit they were 57.2°, 13.4° and 44.3°, respectively. Regarding the progression of slippage, in 22% of patients a progression of more than 5° was seen, but only 11% progressed more than 10°. Four patients presented with low-grade spondylolisthesis at the first visit, and at the last visit a slip greater than 39° was observed. **Conclusion:** We found that spinopelvic parameters are not associated with initial severity and progression of spondylolisthesis. Also, we can affirm with our series that spondylolisthesis in patients under 10 years of age progressed in 22% of cases, and there was no major predictor for these patients. With this series of children, it was possible to characterize the spinopelvic parameters of patients with spondylolisthesis, which to date has not been reported.

P-80
Abstract ID 86

A shifting female-to-male ratio of individuals requiring surgery for adolescent idiopathic scoliosis: a 15-year edit prospective observational study. ***Jérémie Thibault,[1] Julie Joncas,[2] Soraya Barchi,[2] Stefan Parent,[1,2] Marie Beausejour,[2] Jean-Marc Mac-Thiong.[1,2,3]* From the [1]Department of Orthopedic Surgery, Université de Montréal, Montréal, Que.; the [2]Centre de recherche du CHU Sainte-Justine, Montréal, Que.; the [3]Research Centre, Hôpital du Sacré-Cœur, Montréal, Que.**

Background: Historically, the overall female-to-male ratio for adolescent idiopathic scoliosis (AIS) has ranged between 1:1 and 3:1. Our experience suggests that the proportion of boys requiring AIS surgery is increasing, but there is no recent study supporting this clinical intuition. This study compared the preoperative characteristics and health-related quality of life scores between boys and girls scheduled for AIS surgery. **Methods:** A prospective observational cohort of 920 individuals scheduled for AIS surgery between 2008 and 2022 was analyzed. Age, sex, female-to-male ratio, Risser sign, maximum Cobb angle and Scoliosis Research Society-22r (SRS-22r) Patient Questionnaire scores were collected. Patients' characteristics and health-related quality of life were compared between boys and girls using Mann–Whitney tests for each year, and their relationship with year was assessed from Spearman correlations. **Results:** The overall female-to-male ratio for curves of 10° or more was between 2.0 and 3.0 between 2016 and 2022. For surgical patients, the mean ratio was 6.2 between 2008 and 2015, and 3.9 between 2016 and 2022, with a minimum of 2.9 and 2.8 in 2021 and 2022, respectively. The ratio decreased over the years ($\rho = -0.55$, $p = 0.03$). The number of boys requiring surgery increased ($\rho = 0.69$, $p = 0.004$), while the number of girls remained constant over the years. Males tended to have improved SRS-22r scores overall, and prospective self-image increased for both males and females. In more recent years, males experienced less pain and tended to experience better mental health in the preoperative period. **Conclusion:** Current female-to-male ratios under 3:1 for individuals scheduled for AIS surgery is in sharp contrast with the literature. This is surprising considering that the overall ratio (for curves of any severity) remained constant over the years, in line with historical reports.

P-81
Abstract ID 93

Clinical and radiological outcomes of gradual reduction and circumferential fusion of high-grade spondylolisthesis in adolescents. A prospective cohort study of 29 young patients. ***Antoine Dionne,[1,2,3] Jean-Marc Mac-Thiong,[1,2,3] Stefan Parent,[1,3] Jesse Shen,[1,4] Julie Joncas,[3] Soraya Barchi,[3] Hubert Labelle.[1,3]* From the [1]Université de Montréal, Montréal, Que.; the [2]Centre de Recherche de l'Hôpital du Sacré-Cœur de Montréal, Montréal, Que.; the [3]Centre Hospitalier Universitaire Sainte-Justine, Montréal, Que.; the [4]Centre Hospitalier de l'Université de Montréal, Montréal, Que.**

Background: The safety and efficacy of formal reduction for L5–S1 high-grade spondylolisthesis (HGS) has never been thoroughly examined. As a result, the indication for reduction surgery versus in-situ fusion in this population remains controversial. Therefore, this prospective study reports the outcomes for a cohort of 29 young patients with HGS who underwent gradual reduction and circumferential fusion using a standardized surgical technique. We hypothesized that this technique improves health-related quality of life (HRQOL) and sagittal spinopelvic alignment, and is associated with a low risk of complications. **Methods:** Twenty-nine children (13 males, 16 females) were recruited between 2006 and 2010. Radiographic measurements (including percent slip, lumbosacral angle [LSA], pelvic incidence, pelvic tilt, sacral slope and proximal femoral angle) and HRQOL assessments (Scoliosis Research Society-22r [SRS-22r] Patient Questionnaire) were prospectively obtained at baseline and at the last postoperative follow-up (> 2 yr postoperatively). Radiological measurements were used to classify patients according to the Spinal Deformity Study

Group (SDSG) classification. Bivariate statistics were used to compare radiological and HRQOL variables between the preoperative and last follow-up assessments. **Results:** Mean (± standard deviation) percent baseline slip at presentation was 69.9% (± 16.5%). There were 13 patients with a balanced pelvis (SDSG type 4) and 16 with an unbalanced pelvis (SDSG type 5 or 6). On average, a reduction of 45.5% (± 15.3%) (range 20%–86%) was achieved safely, with no major complication. In particular, of the 29 patients, only 3 had an L5 radiculopathy postoperatively; it was self-resolved at follow-up. From a radiological standpoint, we observed a mean improvement of LSA from 80.3° (± 17.9°) to 91.7° (± 13.6°). We also observed a statistically significant improvement in global HRQOL, and in the function and body image domains. **Conclusion:** This prospective study suggests that formal reduction of HGS followed by circumferential fusion is safe when using a standardized surgical technique based on gradual reduction. Performing this intervention could also help improve QOL in some patients. Future work is required to further evaluate safety/long-term outcomes at a larger scale.

P-82
Abstract ID 104

Interrater reliability of partially automated segmentation of spinal radiographs in patients with adult spinal deformity using KeOps software. ***Manjot S. Birk, Fred Nicholls, Rémi Pelletier-Roy, Ethan Sanders.* From the University of Calgary, Calgary, Alta.**

Background: The objective was to determine the interrater reliability of partially automated segmentation of sagittal and coronal spinal radiographs of patients with adult spinal deformity (ASD) using KeOps software. **Methods:** Five patients with ASD were specifically selected from our KeOps database to represent instrumented and noninstrumented patients with ASD with sagittal only and coronal and sagittal deformity with preoperative and postoperative full-length sagittal and coronal spinal radiographs. Six fellowship-trained spine surgeons, 1 spine fellow and 1 orthopedic resident, blinded to the patient data, performed segmentation on each image using KeOps software. The data were extracted, and reliability between raters was determined using interclass correlation coefficients with 95% confidence intervals, with values of < 0.70, 0.70–0.79, 0.80–0.89 and 0.90–0.99 considered poor, fair, good and excellent reliability, respectively. **Results:** Analysis is ongoing; however, early results suggest excellent reliability between fellowship-trained spine surgeons and good reliability between the spine fellow and orthopedic resident. Furthermore, we plan to compare our interrater reliability values to published data using digital software and manual segmentation. **Conclusion:** Early analysis suggests that partially automated segmentation of sagittal and coronal spinal radiographs of patients with ASD using KeOps software is not only highly reliable but also provides superior reliability when compared to manual techniques.

P-83
Abstract ID 117

Recovery patterns and de novo neurological deficits associated with intraoperative neuromonitoring alerts in cord-level severe spinal deformity surgeries: results from an international multicentre prospective Spinal Deformity Intraoperative Monitoring (SDIM) study. ***Stephen Lewis,[1] Yousef Aljamaan,[1] Lawrence G. Lenke,[2] Justin Smith,[3] Zeeshan Sardar.*[2] From the [1]University of Toronto, Toronto, Ont.; [2]Columbia University, New York, N.Y.; the [3]University of Virginia, Charlottesville, Va.**

Background: The objective was to report on the recovery patterns during surgery and the de novo neurological deficits at discharge associated with intraoperative neuromonitoring (IONM) alerts during severe spinal deformity surgeries. **Methods:** Twenty international centres documented the IONM. Inclusion criteria were age > 10 and < 80 years, neurologically intact, undergoing spinal deformity correction with a major Cobb angle > 80°, or undergoing a posterior column or 3-column osteotomy with electromyography (EMG), somatosensory evoked potential (SSEP) and motor-evoked potential (MEP) monitoring. Neurological examination was performed at baseline, postoperatively and prior to discharge. IONM change was defined as a loss of amplitude of > 50% in SSEP or MEP from baseline, or sustained EMG activity that lasted > 10 seconds. A de novo neurological deficit was defined as postoperative decrease of 1 point from baseline in American Spinal Cord Injury Association (ASIA) Lower Extremity Motor Score and/or worsening in sensory function from baseline and/or presence of spinal cord syndrome. **Results:** A total of 555 patients were included, of whom 349 (62.9%) were cord level and included in these analyses. IONM alerts occurred 81 times in 57 cases (16.3%), with 62 alerts of MEP only (33 unilateral, 29 bilateral), 1 SSEP only and 2 EMG only; 16 alerts were combined. Hence, MEP change was found in 78 of 81 alerts. Of the 78 MEP changes, 63 (80.8%) recovered fully, 4 (5.1%) recovered on 1 side, and 11 (14.1%) did not recover. Of the 44 unilateral MEP changes, 8 (18.2%) did not recover, and of the 34 bilateral MEP changes, 3 (8.8%) did not recover on both sides, and 4 (11.8%) recovered on 1 side only. Thirteen (22.8%) of the 57 patients who had IONM alert(s) and 14 (4.8%) of the 292 who did not have IONM alerts had de novo neurological deficits. Actions performed in response to IONM alerts with 22.8% incomplete recovery. **Conclusion:** Of the 78 MEP changes, 19.2% did not fully recover. Thirteen (22.8%) of the 57 patients who had IONM alert(s) and 14 (4.8%) of the 292 who did not have IONM alerts (false negatives) had de novo neurological deficits at the time of discharge.

P-84
Abstract ID 122

An evaluation of postsurgical pain management: oral-only morphine versus combined oral and intravenous patient-controlled analgesia in patients with scoliosis. ***Elen Mullaj, David Lebel, Jennifer Dermott, Natasha Bath, Karen Mathias, Deepa Kattail.* From The Hospital for Sick Children, Toronto, Ont.**

Background: Postoperative pain following posterior spinal fusion (PSF) hinders recovery. Intravenous patient-controlled analgesia (IV-PCA) is common but limits patient mobility and demands significant medical resources. Oral opioids offer a non-invasive alternative with a lower risk of infection and improved mobility. This study examined the effectiveness of combined oral

and IV-PCA versus oral-only analgesics in the context of an Enhanced Recovery After Surgery (ERAS) protocol, which emphasizes early mobilization, urinary catheter removal, intrathecal morphine use and nonsteroidal anti-inflammatory drugs. **Methods:** This retrospective cohort study included 39 patients with adolescent idiopathic scoliosis (AIS) who underwent PSF surgery by 1 physician and were treated with ERAS. Patients were divided into those who received oral + IV-PCA or oral-only opioids postoperatively. Independent samples *t* tests and χ^2 tests were used to assess group differences. **Results:** Twenty-five patients receiving oral + IV-PCA and 14 receiving oral-only analgesics were evaluated. Oral-only patients had significantly shorter stays (mean 52.9 h [standard deviation (SD) 9.3 h] v. 70 h [SD 33.5 h, $p = 0.023$). Morphine consumption was significantly reduced at 0–12 hours (9.46 v. 29.42 morphine milligram equivalents, $p < 0.001$) and 12–24 hours ($p = 0.003$) after surgery for the oral-only group compared to the oral + IV-PCA group. However, no differences in morphine consumption were noted at 24–36 or 36–48 hours. No differences in pain as reported by the clinical care team were observed at 0, 12, 36 or 48 hours, or 2 weeks postoperatively; however, at 24 hours postoperatively, oral-only patients had significantly higher pain than oral + IV-PCA patients (0.027). While changes in pain, function, mental health and satisfaction domains for the Scoliosis Research Society-22 (SRS-22r) questionnaire before and after surgery did not differ between groups, oral-only patients reported better self-image ($p = 0.001$) after surgery. **Conclusion:** Study findings suggest that oral-only analgesics can lead to shorter hospital stays, lower initial morphine consumption and similar pain outcomes in most cases. This further enhances the potential for oral-only analgesics to be used as a safe, efficient strategy for pain management, promoting earlier mobility while reducing the risks of complications and costs often associated with IV administration.

P-85
Abstract ID 129

Saving spinal cord function by using intraoperative monitoring and rapid response during spinal deformity surgery. ***Ariel Zohar,[1] Janneke Loomans,[2] Ferran Pellise,[3] Justin S. Smith,[4] So Kato,[5] Zeeshan Sardar,[6] Lawrence Lenke,[6] Stephen J. Lewis.[1]***
From the [1]University of Toronto, Toronto, Ont.; the [2]AO Foundation, Amsterdam, Netherlands; the [3]Vall d'Hebron University Hospital, Barcelona, Spain; the [4]University of Virginia, Charlottesville, Va.; the [5]University of Tokyo, Tokyo, Japan; [6]Columbia University, New York, N.Y.

Background: The objective was to evaluate the effectiveness of intraoperative neuromonitoring (IONM) in preventing neurologic deficits during complex cord-level deformity operations. **Methods:** Twenty international centres prospectively documented IONM, demographics, radiographic findings and surgical events of patients undergoing spinal deformity correction. Inclusion criteria were age 10–80 years, neurologically intact, major Cobb angle > 80° or undergoing any spinal osteotomy with electromyography (EMG), somatosensory evoked potential (SSEP) and motor-evoked potential (MEP) monitoring. Detailed neurological examination was performed at baseline, immediately postoperatively and prior to discharge from hospital. IONM change was defined as amplitude loss of > 50% in SSEP or MEP from baseline or sustained EMG activity that lasted > 10 seconds. **Results:** Of 349 patients with cord-level deformity correction, 16.3% had at least 1 IONM alert. Alerts were seen in patients with significantly larger coronal Cobb angles (73.4° v. 61.3°, $p = 0.008$) and higher coronal deformity angular ratios (DARs) (11.0 v. 8.3, $p < 0.001$). There were 81 IONM alerts in total. A single IONM alert was most common (71.9%), followed by 2 alerts (19.3%) and 3 alerts (7.0%). Changes in MEPs without SSEP or EMG were most common (76.5%; unilateral 53.2%, bilateral 46.8%). Combined MEP and SSEP alerts occurred in 13.6% of all alerts. Most events prior to the MEP alert were surgical (80.8%) and involved release/osteotomy (41.3%), correction/rod placement (38.1%) and instrumentation placement (17.5%). Osteotomy/release was the most common cause of unilateral MEP alerts, whereas rod placement/correction was the most common cause of bilateral MEP alerts. Rapid corrective actions (i.e., elevating blood pressure, transfusion, anesthesia adjustments, rod or implant removal, steroid administration, correction attenuation and decompression) reversed 80% of the MEP changes. One-quarter of patients with IONM alerts had new neurological deficits, 21.4% had motor dysfunction, and 5.8% had sensory dysfunction. False negatives occurred in 4.9% of patients without IONM alerts. **Conclusion:** IONM alerts are more common in complex spinal operations with larger Cobb angles and DARs, usually manifested in MEP changes. IONM is valuable but has a 4.9% false-negative rate, which highlights the need for more sensitive detection modalities.

P-87
Abstract ID 145

Structure–function relationships of degenerative and degenerative scoliosis annulus fibrosus — a possible etiological factor in adult deformities. ***Taylor J. Bader, Manmeet Dhiman, David Hart, Neil Duncan, Paul Salo, Ganesh Swamy*. From the University of Calgary, Calgary, Alta.**

Background: Intervertebral disc (IVD) degeneration is an age-related progressive structural failure of the disc which can lead to instability of the motion segment. The resultant condition can be debilitating and painful, requiring surgery. Furthermore, as degeneration occurs, some patients develop further deformities in the form of degenerative scoliosis (dScoli) and degenerative spondylolisthesis (dSpondy). The aim of the present study was to measure elastic and viscoelastic shear properties and compare structural histological differences between normal, degenerative and deformity patient samples of the annulus fibrosus (AF). **Methods:** AF samples were collected from 57 patients undergoing anterior and lateral approach surgeries in the L4–L5 and L5–S1 segments (University of Calgary Ethics ID REB18-1308). Normal AF samples were collected from organ donors. Mechanical shear testing of 5-mm³ AF tissue cubes was performed in circumferential and radial shear loading, totalling 10% strain. A subset of the mechanically tested samples was subsequently imaged with optical coherence tomography (OCT) for lamellar structure ($n = 20$) and was scored for degeneration through histology ($n = 42$). **Results:** Shear modulus was significantly increased in normal samples (mean 231 kPa [standard deviation (SD) 73 kPa], $p < 0.01$) but was not significantly different between degenerative (57 [SD 43] kPa), dScoli (36 [SD 27] kPa)

and dSpondy (33 [SD] kPa). Radial shear modulus followed similar but reduced trends. Increases in histological degenerative scores correlated with reductions in the shear modulus of the same AF section (rs –0.64, $p < 0.01$). Radial shear modulus and histology scores were not significantly correlated ($p = 0.15$). OCT-acquired lamellar thickness increased correlated with decreases in the shear modulus of the same AF section (rs –0.77, $p < 0.01$), with similar trends in the radial orientation (rs –0.73, $p < 0.01$). **Conclusion:** These results suggest that the AF in surgical degenerative IVD is less stiff in shear than normal AF. These reductions in shear modulus were correlated to the structural degeneration of the AF as determined by histology and mean lamellar thickness. Decreased shear modulus in AF may contribute to the etiology of dScoli and spinal instability, and is an important target for further characterization.

P-89
Abstract ID 154

The dreaded false negatives: when intraoperative neuromonitoring fails to detect spinal cord and nerve root deficits associated with complex spinal deformity correction — a prospective international study from the AO Spine Knowledge Forum Deformity. ***Stephen Joel Lewis,[1] Peyton Lloyd Lawrence,[1] Justin Smith,[2] Ferran Pellise,[3] Zeeshan Sardar.[4]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]University of Virginia, Charlottesville, Va.; the [3]Vall d'Hebron University Hospital, Barcelona, Spain; [4]Columbia University, New York, N.Y.**

Background: The objective was to assess and compare rates of new neurological deficits relative to intraoperative neuromonitoring (IONM) alerts in cord-level and non-cord-level complex spinal deformity operations. **Methods:** Prospective data on intraoperative neuromonitoring, demographics, radiographic findings and surgical events during deformity correction in 20 international centres were collected. Inclusion criteria were age 10–80 years, neurologically intact, spinal deformity correction with a major Cobb angle > 80° or a posterior column/3-column osteotomy with electromyography (EMG), somatosensory evoked potential (SSEP) and motor-evoked potential (MEP) monitoring. IONM changes were loss of amplitude of > 50% in SSEP or MEP from baseline, or sustained EMG activity that lasted > 10 seconds. Neurological examination was performed at baseline, immediately postoperatively and prior to discharge from hospital. New neurological deficits were 1) postoperative decrease of 1 point from baseline in the American Spinal Cord Injury Association (ASIA) Lower Extremity Motor Score, 2) worsening in sensory function from baseline or 3) presence of spinal cord syndrome postoperatively and compared between cord-level and non-cord-level operations based on IONM alerts. **Results:** A total of 532 patients had data on new postoperative neurological deficits and were included. In all, 11.3% of patients had new postoperative deficits, and 63.3% had no IONM change. Eight percent of cord-level patients had new deficits, and 14% of those had no IONM changes; 17.1% of non-cord-level patients developed deficits, and 72.7% of those had no IONM changes. IONM alerts occurred in 13.5% (15.3% cord-level v. 10.4% non-cord-level). Almost one-third (30.6%) of the cases with IONM alerts had a new postoperative neurological deficit: 45.0% of non-cord-level patients and 25.0% of cord-level patients developed new deficits despite attempts to address alerts. The false-negative rate was 8.3% (13.9% non-cord-level v. 4.9% cord-level operations). Sensitivity of IONM alerts was 27.3% for non-cord-level and 48.1% for cord-level, while specificity was 93.1% in non-cord-level versus cord-level operations (87.5%). **Conclusion:** The false-negative rate appears to be relatively high. More studies are required to examine causative factors such as inappropriate anesthesia, lack of sensitivity of EMG and inadequate channels to monitor sufficient muscle groups.

P-90
Abstract ID 162

What events are associated with intraoperative neuromonitoring alerts in deformity surgeries? Results from the multicentre prospective Spinal Deformity Intraoperative Monitoring (SDIM) study. ***Peyton Lloyd Lawrence,[1] Stephen Joel Lewis,[1] Justin Smith,[2] Ferran Pellise,[3] Zeeshan Sardar.[4]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]University of Virginia, Charlottesville, Va.; the [3]Vall d'Hebron Hospital, Barcelona, Spain; [4]Columbia University, New York, N.Y.**

Background: The objective was to describe the events prior to intraoperative neuromonitoring (IONM) alerts during deformity surgeries. **Methods:** IONM changes such as loss of amplitude of > 50% in somatosensory evoked potential (SSEP) or motor-evoked potential (MEP) from baseline or sustained electromyography (EMG) activity that lasted > 10 seconds were recorded in patients aged 10–80 years who were neurologically intact and undergoing spinal deformity correction with a major Cobb angle > 80° or a posterior column or 3-column osteotomy with EMG, SSEP and MEP monitoring. Cord level was defined as at or above the conus medullaris. **Results:** A total of 349 cord-level and 197 non-cord-level surgeries were included. IONM alerts occurred in 16.3% of the cord-level and 11.2% of the non-cord-level surgeries. At cord level, 78 of 81 alerts had MEP changes, 44 unilateral and 34 bilateral. Osteotomy/release most commonly preceded unilateral (57.9%), and bilateral MEP most commonly followed correction/rod placement (64%). Unilateral MEP changes occurred mainly in type 2 osteotomy (68.2%), whereas bilateral occurred mainly in type 5 or 6 osteotomy (66.7%). MEP changes during decompression were mainly on concave side and unilateral (76.5%). At non-cord-level, 21 of 26 alerts had MEP changes, 16 (50%) unilateral and 5 (66.7%) bilateral. Unilateral and bilateral MEP changes followed osteotomy/release most frequently. Types 2, 3 and 4 osteotomies had similar rates of IONM alerts. Nonsurgical events that preceded unilateral alerts in cord-level surgeries were technical most frequently (9.1%). Anesthesia-related (26.5%) and technical (23.5%) changes were most frequent in bilateral MEP changes. For non-cord-level surgeries, technical issues (25%) most frequently resulted in unilateral changes, whereas systemic events such as low blood pressure or anemia (20%) and technical issues (20%) were found in bilateral MEP changes. **Conclusion:** IONM changes were commonly observed during osteotomy/release, concave side decompression and correction/rod placement in cord and noncord spinal deformity. Further studies are required to determine false-positive rates and clinical significance.

P-92
Abstract ID 15

Meta-analysis of randomized controlled trials comparing radiation exposure in robot-guided versus freehand spinal fusion. ***Jordan J. Levett,[1] Abdulrhman Alnasser,[2] Uri Barak,[2] Lior M. Elkaim,[2] Thien Sa Hoang,[1] Naif M. Alotaibi,[3] Daipayan Guha,[4] Isaac L. Moss,[5] Alexander G. Weil,[1] Michael H. Weber.[2]*** **From the [1]Université de Montréal, Montréal, Que.; [2]McGill University, Montréal, Que.; the [3]King Fahad Medical City, Riyadh, Saudi Arabia; [4]McMaster University, Hamilton, Ont.; the [5]University of Connecticut, Farmington, Conn.**

Background: Robot-guided (RG) pedicle screw placement offers several advantages over freehand (FH) surgery to patients undergoing spinal fusion. Radiation exposure and detrimental risks associated with RG surgery are poorly described in the literature. We performed a systematic review and meta-analysis of randomized controlled trials (RCTs) comparing RG to FH spinal fusion to assess radiation exposure to patients and clinicians. **Methods:** MEDLINE, Embase, Web of Science and Cochrane Central were systematically queried. Inclusion was restricted to RCTs in adults. The primary outcome was radiation time, and dose estimates were extrapolated from these data. Version 2 of the Cochrane risk-of-bias tool for RCTs (RoB 2) was used to evaluate risk of bias. Continuous data were pooled across trials with inverse variance weighting to mean difference (MD), and dichotomous data were pooled with Mantel–Haenszel weighting to odds ratio (OR) with corresponding 95% confidence intervals (CIs). A random-effects model was used if heterogeneity was high ($I^2 \geq 50\%$). We registered the study protocol a priori (CRD42022373605). **Results:** A total of 1042 patients (RG 651, FH 391) from 8 RCTs were included. Radiation time was reduced in the RG group by 39.6% (MD –25.65 s, 95% CI –51.07 to –0.22), with an estimated anteroposterior and lateral dose–area product in the RG group measuring 123.85 cGy*cm^2 (standard deviation [SD] 73.12 cGy*cm^2) and 241.08 (SD 142.33 cGy*cm^2), respectively. Estimated cancer risk and detrimental hereditary disorder risk were reduced by 40.2% in the RG group (3.60 × 10–5 [SD 2.12 × 10–5] and 1.31 × 10–6 [SD 7.72 × 10–7], respectively). Intraoperative bleeding volume was reduced in the RG group (MD –61.52 mL, 95% CI –100.16 to –22.87, $p = 0.002$, $I^2 = 48\%$). However, surgical duration was significantly higher in the RG group (MD 12.01 min, 95% CI 1.63 to 22.39). Pedicle screw accuracy and length of hospital stay differences were not significant. **Conclusion:** Radiation exposure to patients undergoing spinal fusion is lower in RG surgery than in FH surgery. These findings can be supported by long-term studies that better characterize radiation dosages associated with these procedures.

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Abstract ID 26

The effects of dynamic pedicle-based stabilization on adjacent segment degeneration: retrospective study at 6-year follow-up. ***Phillip de Muelenaere,[1] Kashif Parvez,[2] John Sun.[3]*** **From the [1]University of Manitoba, Brandon, Man.; the [2]University of Manitoba, Winnipeg, Man.; the [3]University of British Columbia, Victoria, B.C.**

Background: One of the most widespread techniques to treat degenerative lumbar pathology involves lumbar fusion. A complication of lumbar fusion involves adjacent segment degeneration (ASDeg) that may develop years after surgery. Dynamic pedicle-based stabilization (DPBS) techniques were developed to reduce ASDeg but with controversial results. Further rarely studied are the radiologic effects of DPBS alone versus hybrid DPBS with lumbar fusion on ASDeg rates. The aim of this study was to compare long-term radiologic results between patients who underwent DPBS versus those who underwent hybrid DPBS with lumbar fusion. Our secondary aim was to compare our long-term radiologic results with the literature involving lumbar fusion alone. **Methods:** A single-centre retrospective study included patients with degenerative spondylolisthesis and discogenic pain managed with DPBS or hybrid DPBS and lumbar fusion. Cosmic was a dynamic device used in the DPBS procedures of the lumbar spine in this study. Patients were seen in follow-up for radiological assessment to determine ASDeg. **Results:** Eighty-one patients were included, 55 in the DPBS group and 26 in the hybrid DPBS and fusion group. Mean age was 62.9 years in the DPBS group and 58.1 years in the hybrid DPBS and fusion group. The ASDeg rate was 12.7% in the DPBS group and 15.4% in the hybrid DPBS and fusion group. **Conclusion:** This study involved one of the larger DPBS cohorts in the literature. Dynamic stabilization and hybrid dynamic stabilization with fusion provided radiological results that showed ASDeg was reduced compared to lumbar fusion groups in the literature. There was no significant difference between DPBS and hybrid DPBS with fusion with regard to ASDeg rates.

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Abstract ID 30

Relationship between paraspinal muscle cross-sectional area, fatty infiltration and muscle strength in patients with chronic low back pain. ***Olivia C. Iorio,[1] Brent Rosenstein,[1] Neda Naghdi,[1] Maryse Fortin.[1,2]*** **From [1]Concordia University, Montréal, Que.; the [2]School of Health, Concordia University, Montréal, Que.**

Background: Chronic low back pain (LBP) is one of the most prevalent causes of disability worldwide as it negatively affects an individual's quality of life. Chronic LBP is associated with weakened paraspinal muscles, specifically those involved with extension, erector spinae (ES) and multifidus (MF). The relationships between muscle size (e.g., cross-sectional area [CSA]), composition (e.g., fatty infiltration [FI]) and strength, however, is poorly understood and warrants further investigation. This study investigated the relationship between paraspinal muscles CSA and FI, and lumbar extensor muscle strength at each spinal level in subjects with chronic LBP. **Methods:** A total of 25 participants (17 females, 8 males; average age 43.92 yr [standard deviation 11.82 yr]) with chronic LBP were recruited. Isometric contractions were performed to measure the maximum strength of extensor muscles in 7 different angles using the MedX lumbar extension machine. CSA and signal interference (SI) of the ES, MF, psoas (PS) and quadratus lumborum (QL) were measured at mid-disc bilaterally for each lumbar level on IDEAL fat and water axial magnetic resonance imaging. The SI values of water and fat images were used to assess the percent fat signal

fraction (%FSF), representing FI. Spearman's correlation was used to assess the relationship between CSA, %FSF and overall mean strength at each lumbar level. **Results:** Greater ES, MF, PS and QL muscle CSA were positively correlated to higher mean extension strength at the upper 4 spinal levels (L1–L2 to L1–L4) (e.g., r ranged between 0.457 and 0.668), with PS showing the strongest correlations. No correlations were found between CSA and strength at L5–S1 for any of the paraspinal muscles. Percent FSF was not correlated with mean extension strength at any level. **Conclusion:** Paraspinal muscle size is strongly correlated with mean extension strength in individuals with chronic LBP, with the PS muscle showing the strongest correlation at the L1–L4 levels. Further research is needed to clarify the relationship between paraspinal muscle strength and composition, and whether sex and body mass index influence this association in subjects with LBP.

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Abstract ID 46

The role of single-photon emission computed tomography with computed tomography in improving pain outcomes following spine interventions: a systematic review. ***Felicia Manocchio,[1,2] Ran Ankory,[1] Lisa Stallwood,[2] Henry Ahn.[1]***
From the [1]University of Toronto, Toronto, Ont.; the [2]Royal College of Surgeons in Ireland, Dublin, Ireland.

Background: Single-photon emission computed tomography with computed tomography (SPECT/CT) has recently emerged as a potential tool to evaluate diagnostic accuracy in the context of diagnosing degenerative spine disease. However, there is a paucity of literature exploring the degree to which the utilization of SPECT/CT leads to improved pain scores in patients with axial neck and back pain. This systematic review investigated the role of SPECT/CT in improving pain scores following spine interventions. **Methods:** A comprehensive search of electronic databases including PubMed, Embase and Scopus was conducted. Search terms "back pain," "spine" and "SPECT/CT" were used to collect relevant studies. Those that met the inclusion and exclusion criteria were selected and quality assessed using the National Heart, Lung and Blood Institute tool. **Results:** The initial search identified 953 relevant studies with a focus on SPECT/CT and axial neck and back pain. Following abstract and full-text screening, 18 studies with a total of 963 participants were included. These studies encompassed various interventions including surgical (n = 7), interventional–radiological (n = 10) and target-specific (n = 1) procedures. Findings from the present review suggest that SPECT/CT demonstrates significant potential in accurately localizing pathology, resulting in improved pain scores after the intervention. Of the 18 included studies, 16 reported significant improvements in Visual Analogue Scale or Numeric Rating Scale pain scores when SPECT/CT was used as part of the diagnostic investigation. Furthermore, 6 studies compared outcomes from positive-uptake SPECT/CT with negative-uptake SPECT/CT and showed that positive-uptake resulted in significantly improved pain scores after the intervention compared with negative-uptake SPECT/CT. **Conclusion:** SPECT/CT shows promise as a tool to improve postinterventional pain scores in patients with spinal pain. The absence of control groups, small sample sizes and use of retrospective designs in many of the included studies served as a limitation of the present study. This highlights the need for additional well-designed studies to clarify the clinical utility of SPECT/CT in improving pain outcomes in comparison to alternative imaging modalities.

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Abstract ID 82

Development and validation of a magnetic resonance imaging–based scoring system for lumbar spine assessment: a proposal for convolutional neural network integration for future clinical automation. ***Hamza Mahdi,[1] Abdul Naeem,[2] Deven Jhawar,[3] Milad Moradi,[4] Balraj Jhawar.[2]*** **From the [1]Schulich School of Medicine, Mississauga, Ont.; the [2]Windsor Regional Hospital, Windsor, Ont.; [3]Western University, London, Ont.; [4]Windsor University, Windsor, Ont.**

Background: This ongoing study aims to create and rigorously validate a novel scoring system based on magnetic resonance imaging (MRI) for comprehensive lumbar spine health assessment. We propose to subsequently integrate machine-learning techniques, specifically convolutional neural networks (CNNs), to automate this scoring system to improve clinical accuracy and efficiency. **Methods:** A multidisciplinary task force has been assembled consisting of neurosurgeons, radiologists and spine specialists. The team engaged in a critical review of existing scoring methodologies, including the Pfirrmann Grading System and Modic Changes Classification, to synthesize a comprehensive system. These elements are further scrutinized against clinical guidelines and empirical evidence. A selected subset of MRI scans has been used for initial calibration of the scoring criteria. For validation, a diverse data set of 150 MRI scans, representing a range of spinal pathologies and patient demographics, will be independently scored by specialists. Interrater reliability will be assessed using Cohen's κ statistic. In parallel, we are in the process of collecting a large data set of approximately 1000 MRI images for future training of a CNN-based machine-learning model. **Results:** The research is in the data collection phase, and preliminary analysis is pending. **Conclusion:** The anticipated result of this research is the development of a comprehensive, empirically validated scoring system for lumbar spine health. Future integration with machine learning aims to expedite the diagnostic process and reduce variability, potentially setting a new benchmark in spine health care diagnostics.

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Abstract ID 89

From text to meaning to surgery: predicting surgical decisions from semantic analysis of referral communications for lower back pain. ***Steven Qiu, Vithushan Surendran, Victoria Shi, Emily Cheung, Sophie Ngana, Muhammad A. Qureshi, Sunjay V. Sharma, Markian Pahuta, Daipayan Guha.*** **From McMaster University, Hamilton, Ont.**

Background: We describe mining of semantic variables associated with surgery for lower back pain from referral communications using large language models (LLMs). **Methods:** We

reviewed the charts of patients who were referred for lower back pain to our spinal surgical group at Hamilton Health Sciences via a central intake centre. We identified patients with referral letters and spine surgery consultation notes available in digital formats. Letters and notes were extracted, formatted and analyzed for variables relating to the semantics of the letters/notes using an LLM, GPT-3.5 Turbo (version 0613) hosted on Microsoft Azure. In particular, semantic variables were centred around characterization of the patient's symptoms and of trialled interventions. **Results:** In total, 243 patients fit our data criteria, of whom 141 had surgery as their final recommendation. The variable most strongly associated with surgical intervention was explicit classification of the patient's presentation as having components of central stenosis (odds ratio [OR] 3.8, $p < 0.001$). This was followed by classification of the patient's symptoms as debilitating (OR 2.2, $p = 0.004$) and the progression of symptoms (OR 2.1, $p = 0.006$). Interestingly, classification of the patient's presentation as having components of lateral/foraminal pathology was not significantly associated with surgery (OR 0.64, $p = 0.09$). The use of physiotherapy (75.2% v. 78.4%, $p = 0.55$), pharmacologic interventions (36.2% v. 39.2%, $p = 0.63$) and injections of any kind (36.9% v. 35.3%, $p = 0.80$) were not different between surgical and nonsurgical patients. Ineffectiveness of conservative therapies, classified as lack of any noticeable amount of symptomatic improvement, had no association with decision for surgery (OR 1.1, $p = 0.75$). On qualitative assessment, there was no clear simple pattern of association between the variables and surgical intervention (e.g., progressiveness and debilitating nature of symptoms did not always warrant surgery). **Conclusion:** Our data suggest that there are certain clinically important semantics associated with surgery decision in referral letters/consultation notes for lower back pain that can be mined using advanced natural language processing tools such as LLMs.