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Canadian Spine Society

21st Annual Virtual Scientific Conference

Feb. 3, 10, 15, 17 and 24, 2021

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 Objectives: Every year the Canadian Spine Society in conjunction with the Canadian Paediatric Spine Society holds its Annual Scientific Conference. This year, because of the COVID-19 pandemic, our meeting will be totally virtual. The format will be a distributed meeting, hosted on the Canadian Spine Society website, with two-and-a-half-hour sessions every Wednesday during February 2021. Each event will include live paper presentations followed by an online question period. There will be a debate between 2 prominent Canadian surgeons on currently controversial subjects with the opportunity for attendees to respond and vote for a winner. We have engaged 4 international keynote speakers who will address topics related to the overarching themes of the conference. E-posters and case studies will be available for viewing and forum discussions will be held throughout the entire month. Our focus will be on degenerative thoracolumbar pathologies, trauma and spinal cord injury, spinal deformity and cervical myelopathy. Topics from 1 week will also be discussed the following week so attendees will have the opportunity to consider additional aspects. As part of these conversation our speakers will touch on spinal metastatic disease, levering expertise in the time of a health care crisis and gender equality in spine care. The Canadian Paediatric Spine Society will hold a symposium on the surgical management of scoliosis in cerebral palsy. This virtual program offers ample opportunity for sufficient professional contact to share ideas and solutions on a wide range of problems. Our platform has been specifically designed to create a comfortable and extended interaction between clinicians and other interested professionals. It will engage our membership and visitors with our exhibitors in a collegial atmosphere that enhances knowledge sharing and discourages aggressive marketing. Although our Annual Scientific Conference must be a totally virtual experience, it remains the most important spine meeting in Canada.

Disclosure of competing interests: Available at www.spinecanada.ca.

Live Podium Presentations

Presentation A1
Abstract 45

Determining clinically important improvement following surgery for degenerative conditions of the spine: analysis of the Canadian Spine Outcomes and Research Network (CSORN) Registry. ***J. Denise Power*[1], *Anthony V. Perruccio*[1], *Mayilee Canizares*[1], *Greg McIntosh*[2], *Y. Raja Rampersaud*[1,3], *the CSORN Investigators*[2] From the [1]Schroeder Arthritis Institute, Krembil Research Institute, University Health Network, Toronto, Ont.; the [2]Canadian Spine Outcomes and Research Network, Toronto, Ont; and the [3]Division of Orthopaedics, Department of Surgery, University Health Network, Toronto, Ont.**

Background: There is significant variability in clinically important improvement (CII) criteria for spinal surgery that suggest population- and diagnosis-specific thresholds are required to determine surgical success using patient-reported outcome measures (PROMs). This study establishes surgical CII thresholds for 4 common lumbar degenerative spinal diagnoses using accepted anchor-based methodology and commonly used PROMs. **Methods:** CII analysis was conducted using baseline and 1-year data from participants in the Canadian Spine Outcomes and Research Network (CSORN) registry who underwent surgery for lumbar spinal stenosis (LSS), degenerative spondylolisthesis (DS), disc herniation (DH) or degenerative disc (DD) from 2015 to 2018. One-year CII thresholds were determined for the Oswestry Disability Index (ODI), and back and leg Numeric Pain Rating Scales (NPRS). At 1 year, patients reported whether they were much better, better, the same, worse or much worse compared with before their surgery. This was used as the anchor (improved: ≥ "better" v. not improved: ≤ "same") to determine CII thresholds for absolute change and percentage change for PROMs using a receiver operating characteristic (ROC) curve approach, with maximization of the Youden index as primary criterion. Correct classification rates were determined. **Results:** There were 856 participants with LSS (39.1% female, mean age 65.8 yr), 591 with DS (64.1% female, mean age 65.8 yr), 520 with DH (47.5% female, mean age 46.8 yr) and 185 with DD (43.8% female, mean age 50.9 yr). CII for ODI change ranged from –10.0 (DD) to –16.9 (DH). CII for back and leg NPRS change was –2 to –3 for each group. CII for percentage change varied by PROM and pathology group, ranging from –11.1% (ODI for DD) to –50.0% (leg NPRS for DH). Correct classification rates for all CII thresholds ranged from 72.1% to 89.4%. **Conclusion:** This work quantifies Canadian CII thresholds for the ODI and back and leg NPRS for 4 common lumbar spinal surgery cohorts, with high classification accuracy. Our results suggest that use of generic CII across different diagnoses in spine surgery is not advised. This study establishes the first comprehensive set of responder criteria in Canada for broader application and specificity in clinical and research settings and for surgical prognostic work.

Presentation A2
Abstract 31

Cost-utility analysis of microdiscectomy versus nonoperative management for the treatment of chronic radiculopathy secondary to lumbar disc herniation. ***Andrew Glennie*[1],**

Jennifer Urquhart,[2] Prosper Koto,[3] Parham Rasoulinejad,[4] Keith Sequeira,[4] Tom Miller,[5] James Watson,[4] Richard Rosedale,[4] Kevin Gurr,[4] Fawaz Siddiqi,[4] Chris Bailey.[4] **From [1]Dalhousie University, Halifax, N.S.; [2]Lawson Health Research Institute, London, Ont.; [3]Nova Scotia Health, Halifax, N.S.; and [4]Western University, London, Ont.**

Background: The objective of this study was to evaluate cost-utility when comparing early surgery with 6 months of conservative management at the 2-year follow-up point. **Methods:** A decision tree model was created and parameterized using data from a single-centre randomized controlled trial, augmented with institutional cost data. The cost-utility analysis was from the payer perspective. Cost-effectiveness was assessed using the incremental cost-utility ratio (ICUR) and a threshold of willingness to pay (WTP) of Can$50 000 per quality-adjusted life year (QALY). Sensitivity analysis involved probabilistic sensitivity analysis (PSA) and 1-way sensitivity analyses. The results from the PSA were used to construct the 95% confidence interval (CI) around the estimates. **Results:** One hundred and twenty-eight patients were included in the study, accounting for potential outcomes and crossover rates between treatment groups. Patients in the surgical group had relatively higher expected costs but had better expected health outcomes. The ICUR was Can$5816 (95% CI $3029–$30 461) per QALY gained. Probabilistic sensitivity analysis demonstrated that the likelihood that early surgical treatment is cost-effective was 0.99 (9848/10 000 from 10 000 Monte Carlo simulations) at the WTP threshold. **Conclusion:** Early surgery is cost-effective when compared with nonsurgical care. Decision-makers should ensure timely access to surgical care especially in single-payer systems given the extremely favourable cost-utility ratio.

Presentation A3
Abstract 44

Impact of undergoing thoracolumbar spine surgery on patient psychosocial health. ***Samantha Rogers,[1] Neil Manson,[1,2,3] Erin Bigney,[2,4] Amanda Vandewint,[2] Eden Richardson,[2,5,4] Dana El-Mughayyar,[2] Rory McPhee,[2,6] Edward Abraham.[1,2,3]*** **From [1]Dalhousie Medicine New Brunswick, Saint John, N.B.; [2]Canada East Spine Centre, Saint John, N.B.; [3]Saint John Orthopaedics, Saint John, N.B.; [4]Horizon Health Network, Saint John, N.B.; [5]Canadian Spine Outcomes and Research Network, Markham, Ont.; and [6]University of New Brunswick, Saint John, N.B.**

Background: The objective of this study was to investigate the impact of thoracolumbar spine surgery on patients' psychosocial profiles. **Methods:** This prospective observational study of consecutive thoracolumbar spine surgeries used patients enrolled in the Canadian Spine Outcomes and Research Network (CSORN) registry at a single tertiary care centre. Measures of interest were collected from 2014 to 2018 at baseline and 24 months postoperatively. These included the Pain Catastrophizing Scale (PCS), Tampa Scale of Kinesiophobia (TSK), Chronic Pain Acceptance Questionnaire (CPAQ), Multidimensional Scale of Perceived Social Support (MSPSS), the Mental Component Summary (MCS) of the SF-12, and patient expectations for surgery impacts on mental well-being. A repeated-measures analysis of variance (ANOVA) was run ($\alpha = 0.05$). Patients were then divided into cohorts on the basis of whether or not successful improvement in back pain, leg pain and disability was achieved. The parameters for success were a 30% decrease at 24-month follow-up in numerical rating scores for back pain (NRS-B), leg pain (NRS-L) and Oswestry Disability Index (ODI) score or 24-month follow-up scores below the minimal pain (NRS ≤ 3) and disability (ODI ≤ 22) values. Mixed measures ANOVAs were run ($\alpha = 0.05$). **Results:** Data from 214 patients (52.2% female; mean age 57.57 [standard deviation 14.7] yr) were analyzed. The majority of patients (90.7%) expected surgery to improve their mental well-being. On average patients showed significant improvements in PCS, TSK and CPAQ scores ($p < 0.05$), but not in MCS and MSPSS scores ($p > 0.05$), and 72.5% reported that surgery met their mental health expectations. Patients belonging to the cohorts who did not meet parameters for success (29.7% for NRS-L, 30.8% for NRS-B and 40.7% for ODI) showed no change on any psychosocial measure of interest ($p < 0.05$) and were half as likely to report fulfillment of their mental well-being expectations compared with the successful cohort. **Conclusion:** Spine surgery results in significant improvement in pain-related psychosocial variables for the majority of patients. While these improvements were not present in patients who did not meet postoperative parameters of successful reduction in pain and disability, it is notable that worsening of psychosocial health was not evident.

Presentation A4
Abstract 70

A comparison of functional and quality of life improvement in 6 different types of surgery. ***Mina Aziz,[1] Michael Weber,[1] Greg McIntosh,[2] Adriene Kelly,[3] Carlo Santaguida,[1] Jean Ouellet,[1] Rudy Reindl,[1] Peter Jarzem.[1]*** **From [1]McGill University, Montreal, Que.; [2]Canadian Spine Outcomes and Research Network, Toronto, Ont.; and [3]Northern Ontario School of Medicine, Sault Ste. Marie, Ont.**

Background: More than half a billion people suffer from low back pain, which significantly affects their quality of life. The objective of this study is to compare the outcomes of common lumbar spinal surgeries with each other, and with other successful orthopedic procedures. **Methods:** EuroQol 5-dimension (EQ-5D) and Oswestry Disability Index (ODI) improvements of 6 lumbar surgical indications in the Canadian Spine Outcomes and Research Network (CSORN) database were examined. These surgeries were (1) discectomy for radiculopathy, (2) artificial disc for degenerative disc disease (DDD), (3) spinal fusion for DDD, (4) decompression and fusion for degenerative spondylolisthesis, (5) decompression for spinal stenosis and (6) spinal fusion for degenerative scoliosis. Improvements from baseline were assessed at 3, 12 and 24 months. Paired *t* tests were used to determine patient improvement. EQ-5D outcomes were compared with published data for hip and knee replacement. **Results:** A total of 997 patients were identified. All surgical groups had statistically significant improvement from baseline; however, there was large variability within groups. All groups achieved a clinically significant improvement in their functional status (15-point improvement in ODI) except the scoliosis group (ODI score improvements at 24 mo per group were 29.6, 20.3, 17.8, 21.5, 19.1 and 14.7 points, respectively). Comparing quality of life improvement (EQ-5D), all groups improved from baseline and achieved clinically significant improvement (0.1

improvement). At 24 months, improvement was 0.31, 0.21, 0.22, 0.25, 0.22 and 0.29, respectively. Discectomy achieved EQ-5D improvement similar to that achieved by a hip replacement (0.31 v. 0.31). Fusion for DDD, decompression and fusion for spondylolisthesis, decompression for spinal stenosis, and spinal fusion for degenerative scoliosis achieved an equal or greater EQ-5D improvement than that achieved with knee replacement (0.22, 0.25, 0.22 and 0.29 v. 0.22, respectively). **Conclusion:** Five lumbar surgeries in this cohort achieved statistical and clinically significant improvement in patients' function and quality of life. Degenerative scoliosis correction may not result in clinically significant improvement in function but can result in clinically significant improvement in quality of life. The majority of spine surgeries in our list produced results similar to hip and knee arthroplasty.

Presentation A5
Abstract 54

The role of frailty and sarcopenia in predicting adverse events and mortality following en bloc resection of primary bone tumours and isolated metastases of the spine. ***Supriya Singh, Oliver Lasry, Nicolas Dea, Charles Fisher, John Street, Michael Boyd, Raphaële Charest-Morin.*** **From the Vancouver Spine Surgery Institute, Vancouver, B.C.**

Background: En bloc resection of primary bone tumour and isolated metastases in the spine is associated with high rates of adverse events (AEs). The objectives of this study were 2-fold: (1) to determine whether sarcopenia measured by the ratio of the psoas to vertebral body (VB) and frailty measured by the Spine Tumor Frailty Index (STFI) were predictors of AEs, mortality and length of stay (LOS) and (2) to compare the ratio of psoas to VB measured at L3 and L4 in terms of their ability to predict AEs and mortality. **Methods:** In this retrospective analysis of a prospectively collected cohort, patients at a single quaternary care referral centre (January 2009 to December 2019) who underwent an en bloc resection of an isolated spinal metastases or a primary bone tumour were included. Perioperative AEs, demographic data, primary tumour histology, neurologic status, surgical variables, pathologic margins, Enneking appropriateness, LOS and mortality were all collected in our institutional database. The ratio of the psoas to VB was measured on the computed tomographic (CT) scan at L3 and L4. The association between sarcopenia and frailty measurements and any AEs and 1-year mortality was assessed using logistic regression models. The association between sarcopenia and frailty measurements and LOS was assessed using linear regression analyses. **Results:** A total of 112 patients were included in the study. Only 75 patients had sarcopenia measurements available for analysis. The CT measurement at L3 predicted AEs (odds ratio 0.29 per 1 point increase, 95% confidence interval [CI] 0.001–0.74; area under the receiver operating characteristic curve [AUC] 0.85). The CT measurement at L4 performed similarly. The STFI was useful for predicting 1-year mortality in this patient population (OR 5.95, 95% CI 1.21–29.18; AUC 0.80). Sarcopenia measurements and frailty indices were not significant predictors of LOS in hospital. **Conclusion:** Sarcopenia measurements, the ratio of psoas to VB at L3 and L4, and STFI are useful predictors of AEs and mortality following an en bloc resection of spine tumours.

Presentation A6
Abstract 27

Feasibility of achieving planned surgical margins in primary spine tumour: a PTRON study. ***Charlotte Dandurand,[1] Laurence Rhines,[2] Stefano Boriani,[3] Raphaele Charest-Morin,[1] Ziya Gokaslan,[4] Alessandro Gasbarrini,[5] Arjun Saghal,[6] Ilya Laufer,[7] Aron Lazary,[8] Chetan Bettegowda,[9] Norio Kawahara,[10] Michelle Clarke,[11] Yoga Raja Rampersaud,[12] Jeremy Reynolds,[13] Alexander Disch,[14] Dean Chou,[15] John H. Shin,[16] Feng Wei,[17] Francis J. Hornicek,[18] Ori Barzilai,[7] Charles Fisher,[1] Nicolas Dea.[1]*** **From the [1]University of British Columbia, Vancouver, B.C.; the [2]University of Texas, Houston, Tex.; [3]Istituto Ortopedico, Milan, Italy; [4]Brown University, Providence, R.I.; [5]Rizzoli Orthopedic Institute, Bologna, Italy; [6]Sunnybrook Hospital, Toronto, Ont.; [7]Memorial Sloan Kettering Cancer Center, New York, N.Y.; [8]National Center for Spinal Disorders, Budapest, Hungary; [9]Johns Hopkins Hospital, Baltimore, Md.; [10]Kanazawa Medical University, Kanazawa, Japan; [11]Mayo Clinic, Rochester, N.Y.; [12]Toronto Western Hospital, Toronto, Ont.; [13]Oxford University, Oxford, U.K.; [14]Dresden University, Dresden, Germany.; the [15]University of California San Francisco, San Francisco, Calif.; [16]Massachusetts General Hospital, Boston, Mass.; [17]Peking University Third Hospital, Beijing, China; and [18]UCLA Health, Los Angeles, Calif.**

Background: Appropriate oncologic resection of primary spine tumours is associated with lower recurrence rates. Even in the most experienced hands, however, executing a meticulously drafted plan sometimes fails. The goal of this study was to determine how successful surgical teams are at achieving planned surgical margins and how successful surgeons are at assessing margins intraoperatively. A secondary objective was to identify factors that might influence successful execution of the planned resection. **Methods:** Primary Tumor Research and Outcome Network (PTRON) is a multicentre international prospective registry for the management of primary tumours of the spine. Using this registry, the primary end points of the present study were to compare (1) the planned surgical margin and (2) intraoperative assessment of the margin by the surgeon to the postoperative assessment of the margin by the pathologist. Univariate analyses were used to assess factors associated with successful execution of the planned resection. **Results:** A total of 258 patients were included. Successful achievement of the surgical plan was attained in 193 patients (74.8%). Margins achieved intraoperatively were correctly assessed in 206 patients (79.8%) compared with the final pathologist assessment. On univariate analysis, the location of the tumour and the number of stages had a statistically significant influence on successful achievement of planned margins. **Conclusion:** To our knowledge, this is the largest study to assess how successful experienced surgical teams are at achieving their surgical plans. We showed that even in high-volume cancer centres, planned surgical margin can only be achieved in three-quarters of cases. The morbidity of the proposed intervention has to be seen in the context of the expected rate of success to optimize patient management and surgical decision-making.

Presentation B7
Abstract 32
Care providers' perspectives on potential expansion of medical assistance in dying criteria to persons with acute spinal cord injury: a qualitative study. ***Shivani Taub, Darren Nickel, Lilian Thorpe, Janine Brown, Robert Weiler, Gary Linassi, Daryl Fourney*. From the University of Saskatchewan, Saskatoon, Sask.**

Background: Provision of medical assistance in dying (MAiD) under Bill C-14 currently requires the patient to have a reasonably foreseeable death. Legislative changes are anticipated to remove this requirement in response to a recent ruling in Quebec. Patients with traumatic spinal cord injuries (tSCI) have higher rates of suicidal ideation and self-harm for some time after the injury. Providing access to MAiD might, therefore, result in premature death before postinjury adaptation can take place. This project explored the perspectives of care providers of people with tSCI concerning end-of-life decisions, the impact of expanding MAiD criteria, and the role of care providers in cultivating hope. **Methods:** We conducted an interpretive descriptive qualitative study. Semistructured interviews were conducted with 19 multidisciplinary team members of the surgery and rehabilitation teams that care for patients with tSCI. Interviews were recorded and transcribed and thematic analysis was conducted. **Results:** Participants described variability in how people with tSCI initially responded to their injury. These responses included shock, denial, an inability to comprehend their life changes, depressive symptoms and occasional suicidal ideation or actions. Participants had various responses to the potential broadening of the criteria for MAiD. Some were highly concerned about premature death, while others expressed confidence that the existing processes would protect against impulsive decision-making. **Conclusion:** Expanding the criteria for MAiD may provide a greater range of choices for people with tSCI but could also increase premature deaths. Recommendations include increased involvement of eligibility assessors with expertise in spinal cord injury as well as a longer mandatory waiting period, especially in young, vulnerable people with an acute tSCI.

Presentation B8
Abstract 22
Does wait time for transfer from acute care to rehabilitation affect the outcomes following a traumatic spinal cord injury? A prospective cohort study. ***Andréane Richard-Denis,[1,2] Antoine Dionne,[2] Jean Bégin,[1] Jean-Marc Mac-Thiong.[1,2,3]* From the [1]Hôpital du Sacré-Coeur de Montréal, Montreal, Que.; [2]Université de Montréal, Montreal, Que.; and [3]Hôpital Sainte-Justine, Montreal, Que.**

Background: Delay in transfer from acute care to inpatient functional rehabilitation (IFR) after an acute traumatic spinal cord injury (tSCI) is not uncommon. To this day, its impact on the length of rehabilitation and functional outcomes remains unknown, especially for vulnerable groups of SCI patients. The first objective was to determine whether the delay in transfer from acute care (no. of elapsed days between rehabilitation readiness and discharge from acute care) affects the IFR length of stay and functional status following IFR. The secondary objective was to further investigate this relationship with respect to age (< 65 yr v. ≥ 65 yr) and the severity of the tSCI (American Spinal Injury Association Impairment Scale grade A, B, C and D), when accounting for confounding factors. **Methods:** A prospective cohort study including 277 patients admitted to a single level 1 SCI trauma centre was conducted. Partial correlations were performed between the delay in transfer, IFR length of stay and the Spinal Cord Independence Measure (SCIM) at follow-up, adjusting for relevant confounding variables. The same analyses were carried out after stratifying on the basis of age group and the severity of the tSCI. **Results:** The mean delay in transfer from acute care was 7.3 (standard deviation 6.4) days (median 6 d; interquartile range 2–10 d). Delay in transfer was not associated with the IFR length of stay or functional status when adjusted for covariables. However, people aged 65 years and older with a severe injury had lower functional status when exposed to a longer delay in transfer (r = –0.87, p = 0.02). A delay in transfer from specialized acute SCI care up to 29 days had no impact on the IFR length of stay and functional outcome following tSCI. **Conclusion:** A multidisciplinary acute rehabilitation team in a specialized SCI centre may be able to minimize negative effects of delayed admission to IFR. However, more attention should be given to elderly people who have sustained severe SCI when they face delays in transfer from acute care.

Presentation B9
Abstract 86
Investigating and validating quantitative MRI biomarkers for demyelination, axon integrity and inflammation after traumatic spinal cord injury. ***Sarah Morris,[1,2,3] Andrew Yung,[1,3,4] Shana George,[1] Valentin Prevost,[1,3,4] Andrew Bauman,[1,3,4] Piotr Kozlowski,[1,2,3,4] Farah Samadi,[1,5] Caron Fournier,[1,5] Lisa Parker,[6] Kevin Dong,[1] Femke Streijger,[1] G.R. Wayne Moore,[1,5,6,7] Cornelia Laule,[1,2,3,5] Brian Kwon.[1,8]* From the [1]International Collaboration on Repair Discoveries (ICORD), Vancouver, B.C.; the [2]Department of Physics and Astronomy, University of British Columbia, Vancouver, B.C.; the [3]Department of Radiology, University of British Columbia, Vancouver, B.C.; the [4]UBC MRI Research Centre, University of British Columbia, Vancouver, B.C.; the [5]Department of Pathology and Laboratory Medicine, University of British Columbia, Vancouver, B.C.; [6]Vancouver General Hospital, Vancouver, B.C.; the [7]Department of Medicine, University of British Columbia, Vancouver, B.C.; and the [8]Vancouver Spine Surgery Institute, University of British Columbia, Vancouver, B.C.**

Background: Traumatic spinal cord injuries (SCI) are heterogeneous in severity, neurologic level and injury mechanism. Specific aspects of tissue damage, such as axon loss, demyelination, inflammation and edema, vary spatially and over time after injury. Empirical in vivo measurements of SCI damage would be very useful for prognosis and as a biomarker for clinical trials. Our overall objective is to establish magnetic resonance imaging (MRI) biomarkers for damage after traumatic SCI by leveraging our unique opportunity to correlate quantitative MRI measures with both the underlying pathology of SCI and clinical neurologic impairment. **Methods:** Eleven whole formalin-fixed spinal cords from the International Spinal Cord Injury Biobank underwent high-field advanced MRI scans sensitive to a range of tissue components including myelin, axons, edema and inflammation.

Injury–death interval (IDI) ranged from 1 to 112 days. After MRI, the cord was sectioned and stained with histopathologic stains for myelin phospholipids, myelin proteins, axons and inflammatory cells. MRI and histology in ascending sensory and descending motor white matter tracts were quantitatively compared. **Results:** Three MRI metrics sensitive to myelin (myelin water fraction [MWF], inhomogeneous magnetization transfer [ihMT] and radial diffusivity [RD] from diffusion tensor imaging) were found to significantly correlate with Luxol fast blue (LFB) staining for myelin phospholipids in the injury epicentre. RD had the strongest correlation with LFB (R = –0.719), followed by MWF (R = 0.675) and then ihMT (R = 0.650). We saw evidence for Wallerian degeneration in MRI biomarkers for myelin, axons and inflammation in the 2 cords with IDI greater than 60 days but not in cords with shorter IDI. Histopathologic data analysis is ongoing as well as MRI biomarker correlation with neurologic impairment. **Conclusion:** The 3 myelin-sensitive MRI metrics investigated were validated as myelin biomarkers in human SCI. Initial analysis establishes a time frame for the detection of Wallerian degeneration with these MRI methods. Further analysis of this exciting data set will validate additional MRI metrics and give insight into the histopathology of SCI.

Presentation B10
Abstract 23
Does participating in a national spinal cord injury registry improve actual patient outcomes? ***Andréane Richard-Denis,[1,2] Louis-Felix Gravel,[1,2] Antoine Dionne,[1,2] Etienne Bourassa-Moreau,[1,2] Gilles Maurais,[1,2] Paul Khoueir,[1,2] Jean-Marc Mac-Thiong[1,2]*.** **From the [1]Hôpital du Sacré-Coeur de Montréal, Montreal, Que.; and the [2]Université de Montréal, Montreal, Que.**

Background: Maintaining patient registries is both costly and time consuming, and it is therefore important to assess their actual benefits for patient-centred care to justify their continued use. The aim of this study is to determine if participating in a national spinal cord injury (SCI) registry improves actual patient outcomes and continuum of care. **Methods:** This cohort study compared the outcomes of 444 patients who participated in the Rick Hansen Spinal Cord Injury Registry and 140 patients who declined to participate. Multivariable regression analyses were performed to assess the association between patient participation and outcomes, while accounting for covariables. The main outcomes were compliance with 12-month follow-up, admission to inpatient rehabilitation, inpatient length of stay, 1-year mortality and acute complications. **Results:** Participating in the registry was the only significant predictor of improved compliance with follow-up (adjusted odds ratio [OR] 23.40, 95% confidence interval [CI] 13.25–41.32). It was also associated with reduced 1-year mortality (OR 0.08, 95% CI 0.03–0.22), decreased occurrence of pressure injury (OR 0.39, 95% CI 0.24–0.64) and increased admission to inpatient rehabilitation (OR 2.42, 95% CI 1.53–3.84). Participating in the registry was not associated with pneumonia, nor with the acute or rehabilitation length of stay. **Conclusion:** This study demonstrates the existence of actual patient-centred benefits in terms of outcomes and continuum of care when patients consent to participate in a national SCI registry. There is a need to improve the outcomes of patients declining to participate in a SCI registry.

Presentation B11
Abstract 79
Can individuals expect normal quality of life following traumatic spinal cord injury? A cohort study compared with Canadian normative data. ***Victor Lim,[1] Andréane Richard-Denis,[2,3] Antoine Dionne,[1] Étienne Bourassa-Moreau,[4,5] Jean Bégin,[6] Jean-Marc Mac-Thiong.[4,5,7]*** **From the [1]Faculty of Medicine, University of Montreal, Montreal, Que.; the [2]Department of Medicine, University of Montreal, Montreal, Que.; [3]Physical Medicine and Rehabilitation, Hôpital du Sacré-Coeur de Montréal, Montreal, Que.; the [4]Department of Surgery, University of Montreal, Montreal, Que.; [5]Orthopaedic Surgery, Hôpital du Sacré-Coeur de Montréal, Montreal, Que; the [6]Hôpital du Sacré-Coeur de Montréal Research Centre, Montreal, Que.; and [7]Orthopaedic Surgery, Centre hospitalier universitaire Sainte-Justine, Montreal, Que.**

Background: This study aims to describe the expectations to achieve normal quality of life (QoL) among Canadian traumatic spinal cord injury (tSCI) patients when compared with Canadian normative QoL values based on age and sex. It also aims to determine the effect of older age and severity of SCI on achieving normal QoL. We defined normal QoL as a score within 2 standard deviations of the mean of one's sex and age group. **Methods:** A review of prospectively collected data was conducted on patients admitted acutely at a single level 1 trauma centre. We included patients older than 18 years of age with a baseline level of injury between C1 and S2. We assessed QoL using the SF-36 physical and mental component summary (PCS and MCS) scores obtained within 1 year after injury. **Results:** Of the 264 individuals included in the study, 38.3% displayed normal PCS, whereas 77.8% displayed normal MCS. The proportion of patients who displayed normal PCS was significantly higher in individuals aged 65 years or older (61.3% v. 31.2%; $\chi^2 = 17.5$; $p < p < 0.001$) and in patients with less severe SCI ($\chi^2 = 38.7$; $p < 0.001$). We noted no differences in MCS across age groups or grades of severity for SCI. When we adjusted for potential confounders, age group was no longer significantly associated with achieving normal PCS following tSCI. **Conclusion:** Accounting for age-related QoL variations in the normal population is important when counselling patients after tSCI. More severe SCI are associated with a decreased likelihood of reaching normal PCS, while the likelihood of achieving normal MCS is not affected. Geriatric tSCI patients are as likely as younger patients to experience normal QoL, and a patient's age should not influence clinicians when discussing long-term expectations for QoL.

Presentation B12
Abstract 79
Is the conversion of the American Spinal Injury Association Impairment Scale grade clinically meaningful for functional recovery in all patients with traumatic spinal cord injury? ***Pascal Mputu Mputu,[1,2] Marie Beausejour,[3,4] Andréane Richard-Denis,[5,6] Jean Begin,[1] Antoine Dionne,[5] Jean-Marc Mac-Thiong.[5,7]*** **From the [1]Hôpital du Sacré-Coeur de Montréal Research Centre, Montreal, Que.; the [2]Department of Biomedical Sciences, Université de Montréal, Montreal, Que.; the [3]Department of Community Health**

Sciences, University of Sherbrooke, Longueuil, Que.; the [4]Sainte-Justine University Hospital Research Centre, Montreal, Que.; the [5]Hôpital du Sacré-Cœur de Montréal, Montreal, Que.; the [6]Department of Medicine, Université de Montréal, Montreal, Que.; and the [7]Department of Surgery, Université de Montréal, Montreal, Que.

Background: The objective of this study was to determine whether the conversion of the American Spinal Injury Association Impairment Scale (AIS) or the achievement of a specific grade better reflects functional status and independence 1 year after a traumatic spinal cord injury (tSCI). **Methods:** Using data from a prospective cohort of patients with tSCI managed at a single level 1 trauma centre, we assessed the impact of the conversion of AIS grade and the final AIS grade achieved on the 1-year Spinal Cord Independence Measure (SCIM) score and the recovery of functional independence. **Results:** The conversion of 1 AIS grade was associated with improvement in the SCIM score only in individuals with an initial AIS grade C or D. Regardless of their initial grade, individuals who achieved a final AIS grade D had a significantly higher SCIM score at 1 year than those who did not reach AIS D (89.3 ± 15.2 and 52.1 ± 20.4 respectively, $p < 0.001$); they also were more likely to reach functional independence than those who could not achieve AIS D (68.5% and 3.6%, respectively, $p < 0.001$) irrespective of the number of grades converted. In multivariable analysis, significant predictors of the SCIM were final AIS grades D (β 3.716, 95% confidence interval [CI] 2.77–4.66) and E (β 4.422, 95% CI 2.91–5.93). **Conclusion:** Achieving AIS grade D or better 1 year after tSCI is associated with improved function and is more clinically meaningful than AIS grade conversion. Conversion of 1 AIS grade is meaningful for individuals with initial AIS grades C or D and less clinically useful for those with initial AIS grades A and B.

Presentation C13
Abstract 101

Predicting massive intraoperative blood loss in adult spinal deformity surgery. ***Alex Soroceanu*,[1] *Justin Scheer*,[2] *Themistocles Protopsaltis*,[3] *Munish Gupta*,[4] *Peter Passias*,[3] *Jeffrey Gum*,[5] *Justin Smith*,[6] *Shay Bess*,[7] *Virginie Lafage*,[8] *Christopher Ames*,[2] *Eric Klineberg*.[9] From the [1]University of Calgary, Calgary, Alta.; the [2]University of California San Francisco, San Francisco, Calif.; [3]New York University, New York, N.Y.; [4]Washington University, St. Louis, Mo.; the [5]University of Louisville, Louisville, Ky.; the [6]University of Virginia, Charlottesville, Va.; the [7]Denver International Spine Center, Denver, Colo.; the [8]Hospital for Special Surgery, New York, N.Y.; and the [9]University of California Davis, Sacramento, Calif.**

Background: Because of inherent patient and surgical factors, some adult spinal deformity (ASD) patients are at higher risk of larger blood loss. This is associated with increased risks of complications, coagulopathy and higher requirements for blood component replacement intraoperatively. This study aims to develop and validate a model based on patient characteristics and surgical strategies to predict which patients undergoing ASD surgery are at greater risk of massive intraoperative blood loss. **Methods:** This was a retrospective analysis of a multicentre prospective ASD database. Massive blood loss (mEBL) was defined as an intraoperative blood loss greater than 7% of a patient's ideal body weight. Multivariate logistic regression modelling was used to build a prediction model of mEBL. Potential predictors were identified using univariate analysis. The model was built using a combination of backward elimination and bootstrap selection. Model fit was assessed using the Hosmer–Lemeshow test and the receiver operating characteristic (ROC) curve. Split sample internal cross-validation was performed. The impact of mEBL on complications and intensive care unit (ICU) stay was assessed through multivariate Poisson and logistic regression, adjusting for baseline patient demographics and magnitude of surgery. **Results:** A total of 1205 patients met the inclusion criteria, and mEBL occurred in 7.8% (94/1205) of cases. In this cohort, mEBL was an independent risk factor for major complications (incidence rate ratio 2.89, $p < 0.001$) and postoperative ICU stay (odds ratio [OR] 4.68, $p = 0.001$). Predictors of mEBL included revision surgery (OR 1.66, $p = 0.05$), performing a 3-column osteotomy (OR 2.65, $p < 0.001$), number of levels fused (OR 1.19, $p < 0.001$), number of levels decompressed (OR 1.15, $p = 0.004$) and number of direct lateral interbody fusion (DLIF) interbodies (OR 0.69, $p = 0.066$). The predictive model had a good discrimination (ROC curve 0.76) and good calibration (Hosmer–Lemeshow $p = 0.39$), which held true when we performed split-sample cross-validation. **Conclusion:** We built and validated a model to predict massive intraoperative blood loss in ASD surgery. This tool would be of particular help to members of the anesthesia team, allowing them to identify preoperatively which patients are at greater risk and plan intraoperative care and fluid management accordingly.

Presentation C14
Abstract 102

Use of preoperative opioids is a risk factor for persistent chronic postoperative opioid use in adult spinal deformity patients. ***Ibrahim Sadiq*,[1] *Ariana Frederick*,[2] *Fred Nicholls*,[2] *Peter Lewkonia*,[2] *Ken Thomas*,[2] *Brad Jacobs*,[2] *Ganesh Swamy*,[2] *Nicole Miller*,[2] *Rob Tanguay*,[2] *Alex Soroceanu*.[2] From the [1]University of Alberta, Edmonton, Alta.; and the [2]University of Calgary, Calgary, Alta.**

Background: Opioid use in surgical patients is widespread. A majority of patients wish to undergo surgery to stop medication use. This study examines persistent chronic postoperative opioid use in adult spinal deformity (ASD) patients and the impact on chronic preoperative opioid dependence in this patient population. **Methods:** This was a single-centre study of consecutive ASD patients. Patients were enrolled in a prospective registry. Data on opioid use were collected through chart reviews and converted to oral morphine equivalent per day (MED). Patients were divided into 2 groups on the basis of preoperative opioid use (opioid naive and chronic opioid). The 2 groups were compared in terms of baseline demographics, radiographic parameters, surgical parameters, revision surgery and opioid use 1 and 2 years following surgical intervention. **Results:** A total of 142 patients were included at baseline (opioid naive $n = 51$, and chronic opioid $n = 91$). One-year opioid data were available for 86.6% of patients. Two-year opioid data were available for 71.1% of patients. The 2 groups were similar in terms of baseline demographics, baseline radiographic

parameters and surgical invasiveness. Revision rate for the overall cohort was 30.7% at 2 years, with no statistically significant difference between the 2 groups. One year after surgery, 62.7% of those on chronic opioids before surgical intervention continued to use opioids, versus only 14% in the opioid naive cohort ($p < 0.001$). One-year postoperative average opioid use was 55.3 MED for the chronic preoperative opioid group versus 7.44 MED for the preoperative opioid naive group ($p = 0.005$). Two-year data showed similar results, with 59.4% persistent opioid use among those on chronic opioids before surgery (v. 12.9% in those who were opioid naive before surgical intervention, $p < 0.001$). Two-year postoperative average opioid use was 47.42 versus 3.49 MED ($p = 0.014$). **Conclusion:** Sixty-four percent of ASD patients were on chronic opioid analgesia before surgery. The majority (60%) of these patients continued to use opioids 2 years after surgical intervention.

Presentation C15
Abstract 102
Comparison of a general (NSQIP) and spine specific (SAVES) database for the identification of spine surgery acute care adverse events. ***Chris Daly*,[1,2] *Jenn Nevin*,[1] *Etienne Bourassa-Moreau*,[3] *Marcel Dvorak*,[1] *Charles Fisher*,[1] *Scott Paquette*,[1] *Brian Kwon*,[1] *Nicolas Dea*,[1] *Tamir Ailon*,[1] *Raphaele Charest-Morin*,[1] *John Street*.[1] From the [1]Vancouver General Hospital, Vancouver Spine Surgery Institute, Vancouver, B.C.; [2]Griffith University Gold Coast, Queensland, Australia; and [3]Hôpital du Sacré-Coeur de Montréal, Montreal, Que.**

Background: This project compares the general National Surgical Quality Improvement Program (NSQIP) and spine surgery specific Spine Adverse Events Severity System (SAVES) for identification of adverse events (AE's) and per-patient rates for AEs for adult patients undergoing major spine surgery. **Methods:** All patients, excluding trauma patients, from 2011 to 2018 were identified using Current Procedural Terminology codes in the NSQIP database and matched in SAVES. **Results:** Analysis identified 1460 patients in NSQIP with complete records in SAVES. The average age of included patients was 57.6 (standard deviation 15.8) yr and 54.3% of patients were male. Indications for surgery were varied, with 63.5% of procedures performed electively. Baseline demographic analysis revealed that 45.8% of patients had severe systemic disease, 18% were smokers, 9.8% had diabetes and 5.8% had metastatic cancer. Average length of stay was 13.7 days postoperatively, with 97 patients (6.6%) staying for more than 30 days. NSQIP identified 1008 AEs in 580 patients (39.7%) while SAVES identified 2759 individual AEs in 776 patients (53.1%). Analysis of the 2011–2018 patient cohort revealed that SAVES identified a larger number of adverse events and a larger number of patients who suffered multiple adverse events than NSQIP. SAVES and NISQIP demonstrated 6 specific comparable AEs. SAVES captured 2.28 as many directly comparable adverse events (426) as NISQIP (187) events in these categories. SAVES specific categories identified 178 intraoperative events (e.g., dural tear) not captured by NSQIP. NSQIP specific categories identified 749 medical interventions in 473 patients (32.4%). **Conclusion:** SAVES identified more AEs and more AEs per person than NSQIP. Furthermore, SAVES identified spine surgery specific intraoperative and postoperative complications of direct relevance to patient outcomes. This study highlights the value of specialty-specific AE databases in the accurate capture of adverse events specific to a specialty or subspeciality field. Accurate capture of AEs is essential to the identification of risk factors for poor outcome in spine surgical patients and highlights the importance of appropriate database selection and adoption in surgical quality improvement.

Presentation C16
Abstract 55
Trends in length of stay at a quaternary spinal care centre from 2006–2020. ***Charlotte Dandurand*, *Mathew Hindi*, *Brian Kwon*, *Marcel Dvorak*, *Tamir Ailon*, *Scott Paquette*, *Charles Fisher*, *Raphael Charest-Morin*, *Nicolas Dea*, *John Street*. From the University of British Columbia, Vancouver, B.C.**

Background: Length of stay (LOS) is used by the Canadian Institutes of Health Research as a surrogate for care complexity and is a critical determinant of bed occupancy, capacity and service provision. Over the past 15 years we have undertaken numerous initiatives to reduce LOS of select spine surgical populations. The primary goal of this study was to assess changes in and determinants of LOS at a high-volume quaternary care spine centre. Secondary goals were to identify opportunities for improvement and determinants of future service planning. **Methods:** Data were prospectively collected on all consecutive patients from 2006 to 2020 and included diagnostic category (degenerative, oncology, deformity, trauma, other), mean, median and standard deviation (SD) LOS. **Results:** A total of 14 673 patients were included. Mean age increased from 48.4 years in 2006 to 58.2 years in 2020. The proportion of patients with oncologic disease increased from 6.7% in 2007 to 12.3% in 2020. The proportion of patients with degenerative disease increased from 35.6% in 2014 to 44.3% in 2020. Despite this, overall mean LOS decreased from a mean of 19.5 (SD 43.4) days in 2006 to 10.7 (SD 13.8) days in 2020. Mean LOS for patients with degenerative disease increased from 3.9 (SD 6.0) days in 2006 to 6.8 (SD 23.4) days in 2020. Mean LOS for patients with oncologic disease increased from 15.0 (SD 19.5) days in 2006 to 20.5 (SD 12.2) days in 2019. Proportions and mean LOS for patients with deformity (14.6%, 10.2 d) and trauma (22.7%, 24.6 d) remained stable over time. **Conclusion:** This is the first study to comprehensively analyze trends in LOS over time in spinal surgery. Total population LOS has decreased in the last 15 years because of multiple efforts to enhance perioperative care. However, increasing numbers of patients treated for degenerative and oncologic disease are staying longer in hospital with significant variability in LOS. These findings provide opportunities for intervention and improvement, targeted at specific populations, to reduce length of hospital admission.

Presentation C17
Abstract 89
The impact of the COVID-19 pandemic on scheduled adult spine surgery in Toronto academic health sciences centres (AHSC): a wave 1 through early wave 2 experience. ***Jeremie Larouche*,[1,2] *Joel Finkelstein*,[1,2] *Julia Bowes*,[1,2] *Michael Ford*,[1,2] *Albert Yee*.[1,2] From the [1]Sunnybrook Health Sciences Centre, Toronto, Ont.; and the**

[2]Spine Program, Department of Surgery, University of Toronto, Toronto, Ont.

Background: The pandemic continues to have a significant impact on scheduled surgery. Quantifying the surgical backlog and demand for quality-based procedures is necessary to advocate for resources supporting spinal health for Canadians. This study determined the backlog of adult spine surgeries across Toronto academic health sciences centres (AHSCs), compared activity to common degenerative joint conditions and described our local and regional health system approach in managing demand. **Methods:** Surgical activity was quantified through available local regional and provincial administrative databases. **Results:** Fiscal year-to-date data (April–October) demonstrated that 588 patients were waiting for spine surgery (with an estimated 86-case backlog compared with the same period last year). The median wait was 9 months. Year-to-date volumes were 438 cases (17% reduction compared with the same time last year, range –25% to 23% across 4 adult centres; during this time 1 centre recruited an additional spine surgeon). Year-to-date hip and knee surgical volumes were 1105 and 1961, respectively (–35% and –48% reduction); 990 and 1947 patients awaited surgery, with a backlog of –149 and –397 compared with last year. Compared with 2019, surgery in Ontario ramped up 60% in the weeks leading up to Provincial Directive 2 in mid-March, dropping approximately 90% by mid-April and by approximately 80% by surgical restart of late May, peaking at approximately 15% above 0% in early August and trending between –5% and –30% throughout the fall. In late September, the province issued a 1-time targeted funding initiative for hospitals to prioritize and address surgical backlog including quality-based procedures (QBP) cases. **Conclusion:** A significant reduction in scheduled adult spine surgery was noted during the first 6 months of the fiscal year, with a significant ongoing backlog. Scheduled surgical activity was significantly curtailed during wave 1 of the pandemic to create and protect hospital capacity for COVID-related care. A decrease in referral volumes, in part, may explain the observed negative backlog estimates for hip and knee procedures compared with 2019. From the wave 1 experience, most AHSCs are implementing a staged reduction plan during wave 2 that aims to better protect scheduled surgical activity.

Presentation C18
Abstract 60

Patient acceptance and satisfaction with virtual care in Ontario during and after COVID-19 lockdown restrictions. ***Marcia Correale,[1,2,3] Leslie Soever,[2,3] Maria Rachevitz,[2,4] Andrew Bigness,[5] Sheri Robertson,[6] Renee Wilson,[7] Wesley Wong,[8] Jennifer Nugent,[9] Savvas Frantzeskos,[10] Michael Duffy,[11] Raja Rampersaud,[3,12]*** **From the [1]RAC-LB Operations, University Health Network, Toronto, Ont.; the [2]Department of Physical Therapy, University of Toronto, Toronto, Ont.; the [3]Division of Orthopedics, Arthritis Program, University Health Network, Toronto, Ont.; the [4]Sunnybrook Health Sciences Centre, Toronto, Ont.; [5]Unity Health – St. Michael's Hospital, Toronto, Ont.; [6]Thunder Bay Regional Health Sciences Centre, Thunder Bay, Ont.; [7]Health Sciences North, Sudbury, Ont.; [8]Markham Stouffville Hospital, Markham, Ont.; [9]Windsor Regional Hospital, Windsor, Ont.; [10]Kingston Health Sciences Centre, Kingston, Ont.; [11]Couchiching Family Health Team, Orillia, Ont.; and the [12]Division of Orthopaedic Surgery, Department of Surgery, University of Toronto, Toronto, Ont.**

Background: COVID-19 closures significantly reduced available outpatient services and management resources for patients with low back pain (LBP). In response, Rapid Access Clinics for Low Back Pain in Ontario implemented virtual care (VC) to minimize anticipated backlog and patient deterioration. To optimize rapid implementation, we needed to understand patients' preferences related to VC in the context of an assessment by an unknown health care provider. Objectives of this study were to determine (1) rates and reasons for accepting or declining an initial virtual LBP assessment and (2) satisfaction with VC for LBP. **Methods:** A mixed-methods approach was used. Telephone surveys were completed to determine accept–decline VC rates with reasons during the lockdown period of the pandemic (no in-person option available) and following the lockdown period (both in-person and VC options available). For those who participated in VC an electronic questionnaire with fixed response options and opportunities for open-ended comments was distributed via email. Descriptive statistics and qualitative thematic analysis were applied to the data. **Results:** During lockdown (April and May), 63 survey patients were offered VC and 34 (54%) accepted. Following lockdown (July and August), 102 survey patients were offered either VC or in-person assessment. Sixty-four (63%) accepted VC. During both periods, the main reasons for declining VC were no video, email, computer or Internet (17%), lack of confidence with technology (24%) and preference for in person (8%). A total of 147 postassessment VC satisfaction questionnaires were completed (June–November). Based on a 5-point Likert scale (5 most positive), overall satisfaction with virtual low back assessment was 4.7 and the likelihood of participating in VC again was 4.7. Qualitative analysis revealed 3 main themes: the importance of human connection, patient-perceived virtual physical examination limitations and VC efficiencies. **Conclusion:** Presented with a choice of onsite or VC for LBP after the pandemic lockdown, the majority of patients chose VC. The reasons for declining VC were predominantly related to technologic limitations regardless of timing and assessment type offered. With a high satisfaction rate, VC represents an efficient, patient-centric option for initial assessment and management of LBP.

Presentation D19
Abstract 39

Prospective randomized control study to evaluate the role of injection Cerebrolysin in operated cases of degenerative cervical myelopathy. ***Ayush Sharma,[1] Nandan Marathe,[2] Romit Agarwal.[1]*** **From the [1]Central Railway Hospital, Mumbai, Maharashtra, India; and [2]Toronto Western Hospital, Toronto, Ont.**

Background: Cerebrolysin is a product obtained by the enzymatic degradation of fat free pig brain and is said to have neuroprotective, neurotrophic and neuroregenerative properties. It has been studied with variable success in a variety of neurodegenerative disorders. The aim of this study was to compare the effects of Cerebrolysin in operated cases of degenerative cervical myelopathy (DCM). **Methods:** This prospective randomized controlled trial was conducted at a tertiary care institute in

Mumbai. Sixty operated cases of DCM were randomly divided into 2 groups. All cases were operated by the same surgical team. The first group was given injection Cerebrolysin 5 mL diluted in 100 mL normal saline over 30 minutes once a day for 21 days postoperatively. The second group was given a placebo for the same duration. Modified Japanese Orthopedic Association (mJOA) scores and visual analogue scale (VAS) scores were used to document functional outcomes at 3 weeks, 3 months, 6 months and 1 year. Recovery of hand function was separately accessed by improvement in hand power and sensations. ASIA (American Spinal Injury Association) scores were used to study postoperative neurologic recovery. **Results:** Preoperative mJOA and VAS scores were comparable between the 2 groups ($p < 0.05$). Both groups showed significant improvement in both mJOA and VAS scores at 3 weeks, 3 months, 6 months and 1 year follow-up ($p < 0.01$). On comparing the 2 groups, there was no difference in improvement in mJOA and VAS scores. However, the Cerebrolysin group showed significant improvement in hand function at 1 year compared with the placebo group ($p = 0.03$). Postoperative neurologic recovery was better in the Cerebrolysin group, with 66.7% patients showing complete neurologic recovery compared with 56.7% for the placebo group, but this difference was not statistically significant ($p = 0.32$). No patient had any adverse reactions to Cerebrolysin. **Conclusion:** Use of Cerebrolysin in postoperative cases of DCM is safe and can result in improved neurologic recovery.

Presentation D20
Abstract 47
Association between patient-reported outcomes and construct length in posterior cervical instrumentation for cervical spine myelopathy. ***Raphaële Charest-Morin,[1] Christopher S. Bailey,[2] Jérome Paquet,[3] Nicolas Dea,[4] the CSORN Investigators*. From the [1]Vancouver General Hospital, Vancouver, B.C.; the [2]London Health Sciences Centre, London, Ont.; the [3]Centre hospitalier universitaire de Québec, Québec, Que.; and the [4]Vancouver General Hospital, Vancouver, B.C.**

Background: In multilevel posterior instrumented fusion, crossing the cervicothoracic (CT) junction has been associated with decreased rate of reoperation and pseudarthrosis while resulting in longer surgeries with increased blood loss. However, the impact on patient-reported outcomes remains unknown. The objectives were to determine (1) whether crossing the CT junction influenced patient-reported outcomes (PROs) at 12 months after surgery and (2) the association with intraoperative blood loss (IOBL), length of stay (LOS) and perioperative adverse events (AEs). **Methods:** This is a retrospective study of a prospectively multicentric followed cohort of patients enrolled in the cervical spine myelopathy study between April 2015 and October 2020. Patients who underwent a posterior instrumented fusion greater than 4 levels (between C2 and T2) with 12 months of follow-up were included. Patient demographics, comorbidities, PROs, surgical details, adverse events and length of stay were abstracted. **Results:** Data for a total of 152 patients were analyzed (75 did not cross the CT junction and 77 did). At baseline, patients who underwent a construct crossing the CT junction had more comorbidities, were more likely to be female and had worse modified Japanese Orthopedic Association (mJOA), EQ-5D and Neck Disability Index (NDI) scores ($p < 0.05$). Surgical duration was longer in the group crossing the CT junction (160 v. 188 min, $p < 0.01$). IOBL, perioperative AEs and LOS were not statistically different between groups ($p > 0.05$). When adjusted for baseline scores, there was no statically significant difference in NDI, MJOA, mental component score (MCS), physical component score (PCS) and arm and neck pain NRS change between the groups at 12 months. Adjusted EQ-5D changes were 0.09 and 0.16 in those whose underwent a construct crossing and those who did not, respectively ($p = 0.044$). **Conclusion**: In this cohort of patients with posterior instrumented fusion, crossing the CT junction was associated with longer surgical duration but similar IOBL, LOS and AEs. Improvements in PROs were not significantly different at 12 months between the groups, except for EQ-5D.

Presentation D21
Abstract 52
Rate of revision surgery at adjacent and same segment for cervical disc replacement versus anterior cervical discectomy and fusion. ***James Lee*. From the University of Toronto, Toronto, Ont.**

Background: In recent years, cervical disc replacement (CDR) has gained popularity. The superiority of CDR over anterior cervical discectomy and fusion (ACDF) in terms of rates of secondary surgeries has not been demonstrated in long-term follow-up. This study compares the rates of reoperation in CDR and ACDF for treatment of cervical degenerative disc disease. **Methods:** A population-based cohort study was conducted using health administrative databases including patients undergoing ACDF or CDR between October 2005 and March 2018. Patients receiving CDR versus ACDF were identified using physician claims recorded in the Ontario Health Insurance Program database. Additional details of surgical procedure were obtained from the Canadian Institute for Health Information hospital Discharge Abstract Database. The primary outcome measured was the presence of revision surgery in the cervical spine, defined as an operation more than 30 days from the index procedure. Secondary outcomes were immediate–acute complications within the first 30 days of the index operation. **Results:** A total of 5207 patients were included. Mean follow-up was 2728 days for CDR and 2542 days for ACDF. The rate of revision surgery was 7.5% for ACDF and 8.9% for CDR ($p = 0.41$). CDR trended toward being a risk factor for time to revision in multilevel surgeries (hazard ratio 2.277, 95% confidence interval [CI] 0.993–5.223, $p = 0.05$). ACDF had higher rates of acute complications (7.6% v. 3.3%, $p < 0.01$). Multilevel surgery was a predictor of acute complications (odds ratio [OR] 1.329, 95% CI 1.064–1.660, $p = 0.012$) including dural tears (OR 2.496, 95% CI 1.489–4.184, $p < 0.001$) but not infections. CDR was associated with shorter length of hospital stay (1.42 ± 0.87 v. 2.00 ± 3.08 d, $p < 0.005$). **Conclusion:** The study did not demonstrate superiority of CDR over ACDF in terms of revision rates at index or adjacent level of the cervical spine for single- and multi-level procedures. CDR may have advantages over ACDF in the acute postoperative phase, with shorter length of hospital stay and lower overall complication rates within 30 days.

Presentation D22
Abstract 104
Analysis of complication rates in cervical spine surgery between older patients and younger cohorts using the

CSORN registry: Is age just a number? ***Uchenna Ajoku,[1] Michael Goytan,[1] Greg McIntosh.[2]*** **From the [1]Winnipeg Spine Program, Winnipeg, Man.; and the [2]Canadian Spine Outcomes and Research Network, Markdale, Ont.**

Background: An ambispective review was conducted of consecutive cervical spine surgery patients enrolled by the Canadian Spine Outcomes and Research Network (CSORN) between January 2015 and September 2019. The objective was to compare complication rates between elderly patients and younger cohorts in the intraoperative, perioperative, 3-month postoperative and 1-year postoperative periods. **Methods:** The incidence of degenerative spine disease is increasing, and hence more elderly people are having surgeries. Few studies have examined the temporal nature of complications of cervical spine surgery in the geriatric age group when compared with younger cohorts. **Results:** A total of 860 patients met our study review criteria. There were 195 (22.7%) aged 65 years and older and 665 (77.3%) aged less than 65 years. Intraoperative adverse events between the 2 study groups did not differ significantly (3.9% in patients aged < 65 yr v. 5.6% in patients aged ≥ 65 yr). Perioperatively, the elderly group had more adverse events: 46 (23.6%) versus 83 (12.5%). The most common adverse events were urinary retention (2.3% in the < 65 yr group v. 5.1% in the ≥ 65 yr group), dysphagia (2.1% in the < 65 yr group v. 3.1% in the ≥ 65 yr group) and postoperative pain prolonging hospital stay or requiring readmission (1.2% in the < 65 yr group v. 1.5% in the ≥ 65 yr group). Adverse events at 3 months and 6 months after surgery did not differ significantly between the 2 groups. When we conducted covariate regression analysis, only intraoperative blood loss was associated with not having an intraoperative adverse event (p < 0.001). In the perioperative period, more operated levels, less operating time, shorter length of hospital stay and age less than 65 years were associated with not having a perioperative adverse event. At 3-month and 1-year follow-up, there were no statistically significant factors associated with not having adverse events between the 2 study arms. **Conclusion:** In the 2 age groups, cervical spine surgery is associated with a comparable rate of adverse events in the intraoperative period and the 3-month to 1-year postoperative period. In the 1 month following surgery, elderly patients have significantly more adverse events. Modifiable risk factors that could increase the incidence of adverse events include number of comorbidities, surgical level, surgical approach, intraoperative blood loss and length of hospital stay.

Presentation D23
Abstract 49

Factors associated with increased length of stay in degenerative cervical spine surgery: cohort analysis from the Canadian Spine Outcomes and Research Network (CSORN). ***Eryck Moskven,[1] John Street,[1] Charles Fisher,[1] Bradley Jacobs,[2] Michael Johnson,[3] Jerome Paquet,[4] Hamilton Hall,[5] Christopher Bailey,[6] Sean Christie,[7] Andrew Nataraj,[8] Neil Manson,[9] Philippe Phan,[10] Raja Rampersaud,[5] Kenneth Thomas,[2] Greg McIntosh,[11] Edward Abraham,[9] Andrew Glennie,[7] Peter Jarzem,[12] Henry Ahn,[5] Jocelyn Blanchard,[13] Guy Hogan,[14] Adrienne Kelly,[15] Raphaële Charest-Morin.[1]*** **From the [1]Vancouver Spine Surgery Institute, University of British Columbia, Vancouver, B.C.; the [2]Department of Surgery, University of Calgary, Calgary, Alta.; the [3]Department of Surgery, University of Manitoba, Winnipeg, Man.; the [4]Department of Surgery, Laval University, Quebec City, Que.; the [5]Department of Surgery, University of Toronto, Toronto, Ont.; the [6]Department of Surgery, University of Western Ontario, London, Ont.; the [7]Department of Surgery, Dalhousie University, Halifax, N.S.; the [8]Department of Surgery, University of Alberta, Edmonton, Alta.; the [9]Department of Surgery, Dalhousie University, Saint John, N.B.; the [10]Department of Surgery, University of Ottawa, Ottawa, Ont.; the [11]Canadian Spine Outcomes and Research Network, Toronto, Ont.; the [12]Department of Surgery, McGill University, Montreal, Que.; the [13]Department of Surgery, Université de Sherbrooke, Sherbrooke, Que.; the [14]Department of Surgery, Memorial University, St. John's, Nfld.; and the [15]Department of Surgery, Northern Ontario School of Medicine, Sault Ste. Marie, Ont.**

Background: Prolonged length of stay (LOS) following spine surgery incurs an increased risk and cost for patients and hospitals. Only small studies have investigated the association of patient, surgical and preoperative factors with LOS following commonly performed cervical spine procedures. The objectives were to report on the variability and determine factors associated with prolonged LOS in Canada following anterior cervical discectomy and fusion (ACDF) of less than 3 levels and posterior cervical fusion (PCF). **Methods:** This is a retrospective study of prospectively collected multicentre data consisting of patients enrolled in the Canadian Spine Outcomes and Research Network (CSORN) between January 2015 and October 2020. Patient demographics, cervical pathology, symptom duration and severity, preoperative patient-reported outcomes, surgical centre, perioperative adverse events (AEs) and LOS were abstracted. Multivariable logistic regression analysis was performed to determine the association and odds ratio for risk-adjusted factors on prolonged postoperative LOS, defined as greater than the median LOS per procedure. Bootstrapping statistical techniques were used to internally validate the prediction models. **Results:** A total of 1085 patients were included (ACDF n = 670, PCF n = 415). Mean LOS for the ACDF cohort was 2.0 days (standard deviation [SD] 2.5 d) whereas it was 5.7 days (SD 4.9 d) for the PCF cohort. Median ACDF LOS was 1.0 day (interquartile range [IQR] 0–45 d) and 5.0 days (IQR 1–57 d) for the PCF cohort. Predictors of prolonged LOS following ACDF were female sex (p = 0.013), longer operation time (p < 0.001), greater intraoperative blood loss (p = 0.032) and the occurrence of any perioperative AEs (p < 0.001). Predictors of prolonged LOS following PCF included the occurrence of any perioperative AEs (p < 0.001), nonmarital status (p = 0.013), having no more than a high school education (p = 0.02) and nonsmoking status (p = 0.032). Internal validation receiver operating characteristic (ROC) curves yielded high correct classification values. **Conclusion:** Our study identified several patient, surgical and procedural factors predictive of prolonged LOS following ACDF or PCF. Further studies are needed to determine if quality improvement strategies targeted at enhanced recovery after surgery improve patient care quality and reduce LOS.

Presentation D24
Abstract 51

Association between preoperative sagittal alignment and radiographic measures of decompression following cervical

laminectomy. *Hamza Asif*,[1] *Mina Tohidi*,[2] *Wilma Hopman*,[3] *David Yen*.[2] From the [1]School of Medicine, Queen's University, Kingston, Ont.; the [2]Department of Surgery, Kingston General Hospital, Kingston, Ont.; and [3]Kingston General Hospital, Kingston, Ont.

Background: This study aimed to determine the association between preoperative cervical sagittal alignment and the extent of radiographic postoperative cord decompression following laminectomy. Other objectives included an assessment of the correlation between laminectomy and increasing numbers of levels decompressed on the change in alignment, as well as the effect of laminectomy on preexisting spinal cord signal abnormality. **Methods:** This retrospective cohort study included patients who underwent cervical laminectomies, without fusion, between 2015 and 2020. Chart review was used to collect baseline variables and to measure radiographic changes using preoperative and postoperative magnetic resonance imaging (MRI) scans. Cervical sagittal alignment in the form of the C2–C7 Cobb angle, the width of the spinal cord and the cerebrospinal fluid (CSF) space in front of and behind the cord was measured preoperatively and postoperatively. The correlation between change in measured parameters and preoperative cervical sagittal alignment was assessed using the Spearman correlation. **Results:** Thirty-five patients were included. Their average age was 65.29 (standard deviation [SD] 10.98) years. The majority of patients (80%) underwent laminectomies at 3–4 levels. Average preoperative sagittal alignment determined by the Cobb angle was 6.05° (SD 14.17°), while the average postoperative Cobb angle was 3.15° (SD 16.64°) and the change was not statistically significant (p = 1.0). Eleven patients (32%) had preoperative kyphotic sagittal alignment. The average time from surgery to postoperative MRI scan was 20.44 (SD 13.18) months (range 3–39 mo, median 18.5 mo, interquartile range 23.5 mo). Laminectomy was associated with increased cord width and increased space in front of and behind the cord (p values < 0.001). There was no statistically significant association between increasing levels of decompression and change in cervical spine sagittal alignment (p = 0.55). Spinal cord signal abnormality persisted after decompression. There was a moderate correlation between lordotic preoperative cervical sagittal alignment and change in space in front of the cord (correlation coefficient 0.337350, p = 0.048) and change in cord width (correlation coefficient 0.389, p = 0.021). **Conclusion:** Severity of preoperative kyphotic sagittal alignment is associated with decreased extent of decompression and spinal cord drift. The preoperative sagittal alignment is not significantly associated with the change in alignment. Increasing number of levels decompressed does not worsen alignment.

E-Posters

Presentation P1
Abstract 3
Analysis of the morphometric change in the uncinate process of cervical spondylosis patients: a study of radiologic anatomy. *Esam Nasser Mohammed Al-attar*. From the First Affiliated Hospital, Sun Yat-Sen University, Guangzhou, Guangdong, China.

Background: Although there has been much research focusing on the relationship between the vertebral artery and uncinate process (UP), there are no publications concerning the difference in the dimensions of the UP between the normal spine and degenerative spine, especially in Chinese patients. The purpose of this study was to determine the anatomic parameters that can be used as a guide for the procedure in intervertebral foramen decompression and for analysis of the morphometric change in the UP of patients with cervical spondylosis. **Methods:** Forty patients from January 2016 to January 2019 were enrolled in this study. Three-dimensional computed tomographic scans of the cervical spine were performed. The patients were divided into 2 groups: a nondegenerative cervical spine group (20 cases) and a degenerative cervical spine group (20 cases). Six parameters concerning the height, width and angle of the UP were measured. **Results:** In the nondegenerative group, the average pedicle width was 3.63–5.91 mm from C3 to C7. The average width of safe UP resection will be 3.06 mm at C3, 3.12 mm at C4, 3.28 mm at C5, 2.74 mm at C6 and 2.01 mm at C7. The average safe depth will be 6.04 mm at C3, 6.52 mm at C4, 7.61 mm at C5, 6.07 mm at C6 and 5.09 mm at C7. There were statistically significant differences between the degenerative group and the nondegenerative group, especially for the minimum height of UP, maximum height of UP, medial border's distance of UP and lateral border's distance of UP. **Conclusion:** In patients with cervical spondylosis, intervertebral foraminotomy decompression resecting part of the UP can be performed. The safe range within the spinal column was up to 6.73 mm of width between the inferior vertebral end plate and the superior end plate in intervertebral space and up to 5.09 mm of depth from the medial border of UP to the lateral side at C3 to C7 without interfering with the spinal nerve root.

Presentation P2
Abstract 4
Does body mass index affect outcomes after vertebral body tethering surgery? *Amir Mishreky*,[1] *Stefan Parent*,[2] *Firoz Miyanji*,[3] *Joshua Murphy*,[4] *Ron El-Hawary*.[1] From the [1]IWK Health Centre, Halifax, N.S.; [2]Hôpital Sainte-Justine, Montreal, Que.; [3]BC Children's Hospital, Vancouver, B.C.; and [4]Children's Healthcare of Atlanta, Atlanta, Ga.

Background: The objective of this study was to determine the effect of body weight and body mass index (BMI) on curve correction and on risk of postoperative complications after vertebral body tethering (VBT) surgery. **Methods:** BMI in children has been defined as follows: underweight (< 5th percentile for age), normal (5th to 85th percentile) and overweight (> 85th percentile). This was a retrospective review of prospectively collected study group data. Patients with juvenile or adolescent idiopathic scoliosis with VBT with 2 years of follow-up from a multicentre early-onset scoliosis database were evaluated preoperatively, first

erect, and at 2 years postoperatively. Analysis of variance was used to compare the 3 categories of BMI with significance as per Tukey–Kramer honestly significant difference post hoc test. Risk of scoliosis progression was analyzed with mid-P exact test. **Results:** A total of 121 patients (51 underweight, 58 normal weight, 12 overweight; mean age 12.5 ± 1.6 yr; BMI 18.8 ± 4.6) were identified. After VBT, scoliosis improved over time (51° preoperatively, 29° 1st erect, 28° 2 yr postoperatively; $p < 0.05$). When we compared the underweight, normal and overweight groups, the mean preoperative age (13 yr, 13 yr, 12 yr), preoperative scoliosis (52°, 50°, 52°), preoperative kyphosis (29°, 28°, 33°), perioperative scoliosis correction (44%, 42%, 46%) and complications by 2 years follow-up (23%, 24%, 17%) were similar between the groups. There was 1 broken tether in each of the underweight and normal weight groups. Change in scoliosis percent correction from 1st erect to 2 years postoperatively was not significantly different between the groups; however, the risk ratio for scoliosis progression during this period was 4.74 (1.02–22.02, $p = 0.04$) for overweight patients. **Conclusion:** Overweight patients treated with VBT had similar perioperative scoliosis correction and a similar risk of complications as compared with underweight and normal weight patients. Compared with other patients, overweight patients had a risk ratio of 4.7 for progression of scoliosis during the first 2 years postoperatively.

Presentation P3
Abstract 5
Congenital kyphosis: progressive correction with an instrumented posterior epiphysiodesis. ***Brett Rocos, David Lebel, Reinhard Zeller*****. From the Hospital for Sick Children, Toronto, Ont.**

Background: Congenital kyphosis is a rare condition. In this case series we sought to identify the outcomes and complications of posterior instrumented fusion and the resultant epiphysiodesis effect in uniplanar congenital kyphosis in patients aged 5 years and under. **Methods:** Patients were included if they were treated for a uniplanar congenital kyphotic deformity treated with posterior instrumented spinal fusion while aged under 5 years between October 2006 and August 2017, with a minimum of 2 years of follow-up. Patients were excluded if a coronal deformity greater than 10° was present. **Results:** Six patients met the inclusion criteria. Mean age at surgery was 3.6 years. The mean kyphotic deformity before surgery was 49.7°. All patients underwent posterior instrumented fusion with autogenous iliac crest graft and a cast or brace postoperatively. One patient showed a loss of motor evoked potential on prone positioning, which returned to normal on supine positioning. No patient showed any postoperative neurologic deficits. One patient was diagnosed with a wound infection, which was successfully treated with oral antibiotics. By a follow-up of 5.4 years (range 2.2–10.9 yr) there was no failure of instrumentation. An epiphysiodesis effect (a difference of ≥ 5° in the kyphotic deformity measured between the immediate post- operative and final follow-up lateral whole spine x-ray) of 16.2° (range 7.2°–30.9°) was seen in 5 patients. The mean annual epiphysiodesis effect was 2.7° (95% confidence interval 1.4°–4.1°). No kyphosis proximal to the instrumentation was observed for the duration of follow-up. **Conclusion:** Posterior instrumented fusion and epiphysiodesis is safe and effective. The epiphysiodesis effect occurs in 80% of cases, and the procedure is associated with an acceptable blood loss and a low incidence of neurologic complications.

Presentation P4
Abstract 6
The use of halo gravity traction in severe, stiff scoliosis. ***Brett Rocos,[1] Luke Reda,[1] Michael Dodds,[2] David Lebel,[1] Reinhard Zeller.[1]*** **From the [1]Hospital for Sick Children, Toronto, Ont.; and the [2]Mater Misericordiae University Hospital and Children's University Hospital, Dublin, Ireland.**

Background: The correction of severe, stiff scoliosis in children is challenging because of the risks to the neural structures through acutely stretching the cord and its associated circulation. One method used to reduce the risk is preoperative halogravity traction (HGT) creating a gradual corrective force that is reversible if a patient's condition deteriorates. In this study, we define the safety of HGT and characterize the chronology of the correction seen. **Methods:** Consecutive pediatric patients with major curves exceeding 80° treated with HGT before definitive correction and posterior instrumented fusion were included. A standard traction protocol was employed in each case with the daily addition of weight until 50% of body weight force had been reached at 3 weeks. Traction remained in place until a neurologic complication or 6 weeks, whichever occurred sooner. **Results:** A total of 24 patients were included with a mean age of 11.8 years. The majority of patients showed idiopathic deformities with major thoracic curves with a mean size of 122.5°, a deformity angular ration (DAR) of 16.7° and T1–L5 height of 234 mm. Mean duration of traction was 42 days with a mean improvement in height of 71.5 mm with 82.1% occurring over the first 3 weeks. The improvement in DAR reached 71.5% at 3 weeks. One patient showed a cranial nerve palsy prompting early surgery and 8 patients showed pin loosening, 1 of which required revision of their halo. One patient underwent a slower progression of traction because of urinary disturbance. **Conclusion:** HGT is a safe treatment for severe, stiff scoliosis. It can respond to the patient's neurologic status in real time. In contrast, acute intraoperative correction has a higher risk of neurologic injury because of the stretch applied to both the cord and spinal circulation. Eighty percent of the correction in spinal height and 70% of the angular correction occur in the first 3 weeks according to Hooke's law, with the remaining 20% being due to a viscoelastic effect.

Presentation P5
Abstract 7
Fusing to the pelvis in the correction of scoliosis associated with Rett syndrome. ***Brett Rocos, Reinhard Zeller*****. From the Hospital for Sick Children, Toronto, Ont.**

Background: Rett syndrome is a rare disorder characterized by severe scoliosis in 80% of cases. Posterior spinal fusion has been the mainstay of treatment. Fusing to the pelvis has been shown to influence the function of the spinopelvic relationship, which has been hypothesized to reduce the ability of these patients to ambulate. In this study, we show the results of the treatment of scoliosis in Rett syndrome and analyze the impact of fusing to the pelvis on ambulation. **Methods:** A retrospective case series was used to analyze the radiographic, clinical and functional outcomes of consecutive patients treated for Rett syndrome scoliosis between the ages of 10

and 8 years in a single tertiary pediatric spinal unit. Cases were identified through departmental and neurophysiologic records, and patients were excluded if the diagnosis of Rett syndrome was not confirmed. **Results:** Seven eligible cases were identified. The mean coronal Cobb angle was 90.9°, the mean sagittal Cobb angle was 72.0° and pelvic obliquity 24.5°. The mean postoperative improvement in coronal Cobb was 53.2° and pelvic obliquity was not significantly improved. These did not change during a mean follow-up of 2.7 years. None of the patients showed any postoperative complications and of the 4 patients fused to the pelvis, only 1 was able to ambulate preoperatively, and this ability was lost postoperatively. **Conclusion:** Our data suggest that with modern technology, severe curves can be safely treated and that fusion to the pelvis is not necessary to prevent curve progression, which may be important in preserving patient mobility postoperatively.

Presentation P6
Abstract 8
Tuberculosis of the craniovertebral junction: its altered biomechanics and treatment strategy. ***Sudhir Kumar Srivastava*,[1] *Nandan Marathe*,[1,2] *Sunil Bhosale*,[1] *Aditya Raj*.[1]**
From the [1]Seth Gordhandas Sunderdas Medical College and King Edward Memorial Hospital, Mumbai, Maharashtra, India; and the [2]Toronto Western Hospital, Toronto, Ont.

Background: We have designed a protocol-based management strategy for tuberculosis (TB) of the craniovertebral junction (CVJ). This study will assess functional outcomes of patients with CVJ Koch who were treated using this protocol. **Methods:** A total of 108 patients with TB of the CVJ were managed at a tertiary care university hospital in India over a period of 12 years. Patients were divided radiologically into 3 grades depending on the severity of involvement. Patients were treated either conservatively or surgically using the treatment algorithm. Conservative management strategies included antituberculosis chemotherapy, orthosis and traction. Surgeries performed included occipitocervical fixation and fusion, transarticular screw fixation and fusion, C1–C2 separate fixation (pedicle screw, lateral mass screw, laminar screw). **Results:** Sixty patients were treated conservatively, 28 patients required occipitocervical fusion, 18 patients needed transarticular screws and 2 patients were treated with C1–C2 separate fixation. Six patients had clinically appreciable tilt and 10 patients had axial settling in the conservatively treated group. However, there was no functional impairment. There was no neurologic deterioration in any conservatively treated patient. In the surgically treated group of 48 patients, not a single patient had neurologic deterioration. Out of the 8 patients who were clinically grade 3, 7 patients were ambulatory at 18 months follow-up. One patient remained paraplegic. Fusion was achieved in all cases. **Conclusion:** Although the bacteria and the chemotherapy are the same, TB of the CVJ needs special attention because of the complex anatomy of the region and the presence of vital structures in the vicinity. Early detection, initial rigid orthosis for adequate healing and protocol-based surgical intervention when warranted will give a long-lasting fruitful outcome.

Presentation P7
Abstract 9
Anatomic considerations and functional outcomes of endoscopic transiliac approach for access to L5–S1 disc and foramen. ***Prasad Patgaonkar*,[1] *Nandan Marathe*,[2] *Vaibhav Goyal*.[1]**
From the [1]Indore Spine Centre, Indore, Madhya Pradesh, India; and [2]Toronto Western Hospital, Toronto, Ont.

Background: Transforaminal endoscopic disc surgery has several advantages compared with open surgery. However, the efficacy of the procedure is in doubt when the conventional transforaminal approach is obstructed by anatomic barriers. One such difficult-to-access location is the L5–S1 disc. The purpose of the present study is to analyze the functional outcomes of endoscopic discectomy with the transiliac approach at the L5–S1 level and also provide details of the surgical technique. **Methods:** This study was carried out over a period of 3 years (2015–2018) at a tertiary care spine hospital. Patients with a disc herniation at the L5–S1 level were classified as per the method described by the same authors that has been previously published. Only those patients requiring the transiliac approach were included in the study. To ensure no bias, all patients were operated by the same surgeon, who is also the lead author of this paper. We report the functional outcome data obtained during the 2-year postoperative follow-up period using visual analogue scale (VAS) and Oswestry Disability Index (ODI) scores. **Results:** Transforaminal endoscopic discectomy was performed through the transiliac approach in 62 patients. The VAS score improved, from 8.31 to 2.25 ($p < 0.05$). The ODI score also improved, from 70.23 to 17.71 ($p < 0.05$). No patient deteriorated neurologically, 1 patient had recurrence at the same level managed using selective nerve root block and 1 patient had recurrent disc herniation managed using the interlaminar approach. **Conclusion:** Difficulty in using the transforaminal approach to the L5–S1 space is because of multiple anatomic barriers. Advantages of the transiliac approach include easy removal of central, foraminal or up-migrated disc fragment, no damage to the S1 end plate, reduced risk of injury to exiting nerve root, ease of foraminoplasty, and access to the epidural space. Transiliac endoscopic discectomy is safe and effective for lumbosacral disc pathologies. It can be performed with marking under fluoroscopy with simple orthopedic instruments under local anesthesia. It negates limitations of the transforaminal approach for the L5–S1 disc.

Presentation P8
Abstract 10
Five-year revision rates for elective multilevel lumbar instrumented fusions in the elderly: an analysis of state databases. ***Daniel Cummins*,[1] *Alekos Theologis*.[2]** **From the [1]School of Medicine, University of California San Francisco, San Fransisco, Calif.; and the [2]University of California San Francisco, San Fransisco, Calif.**

Background: Revisions following multilevel lumbar fusion surgery create substantial burden on patient quality of life and health care costs. We sought to evaluate 5-year revision rates as well as indications and modifiable risk factors for revisions following elective multilevel lumbar instrumented fusions in elderly patients. **Methods:** Elderly patients (> 60 yr) who underwent multilevel (≥ 3) lumbar instrumented fusions, based upon *International Classification of Diseases, 9th Revision* (ICD-9) coding, were identified in the Healthcare Cost and Utilization Project (HCUP) state inpatient databases from Florida (2005–2014) and California (2005–2011). Operations for nonelective indications (i.e., fractures, tumour, infections) were excluded. Patients were followed for

5 years for subsequent revision operations and associated indications for revisions (degenerative disease [adjacent segment disease, spondylosis, degenerative disc disease], infection, mechanical failure [including pseudarthrosis], postlaminectomy syndrome, stenosis) using ICD-9 coding. Cox proportional hazards multivariate analyses were performed to determine risks associated with revisions for each diagnostic cause. **Results:** A total of 5636 patients (3285 female; average age at index operation 71.6 yr) were included for analysis. For index operations, the majority were 3–7 levels (97.4%) and mean length of stay was 5.40 days. Overall 5-year revision rate was 16.5%. The most common causes of revision at 5 years were degenerative disease (DD) (50.7%), mechanical failure (32.2%) and stenosis (8.0%). Revision procedure coded at index operation was associated with increased risk of revision for DD (hazard ratio [HR] 1.59, 95% confidence interval [CI] 1.29–1.98, $p < 0.001$) and mechanical failure (HR 1.56, 95% CI 1.19–2.04, $p = 0.020$). Posterolateral spine fusion (PSF) and transforaminal lumbar interbody fusion (TLIF) plus PSF were associated with lower revision risk, compared with anterior lumbar interbody fusion (ALIF) plus PLF (PSF: HR 0.39, 95% CI 0.27–0.55, $p < 0.001$; TLIF + PSF: HR 0.56, 95% CI 0.40–0.79, $p = 0.02$). Male sex was associated with reduced revision risk for DD (HR 0.75, 95% CI 0.62–0.91, $p = 0.04$). Age, race, Charlson Comorbidity Index score, and physician and hospital fusion volumes had no effect on risk of revision. **Conclusion:** Five-year revision rates were 16.5% following elective multilevel lumbar instrumented fusions in elderly patients. Degenerative disease and mechanical failure were the most common causes of revisions. These data may benefit preoperative counselling and shared decision-making of patients considering undergoing multilevel lumbar instrumented fusion.

Presentation P9
Abstract 11
Lumbar PLIF without inpatient admission. Results of a standardized care protocol in over 100 selected patients treated over a 5-year period. ***Drew Bednar*****. From McMaster University, Hamilton, Ont.**

Background: Resource limitations in health care argue for a continued evolution of "doing more with less." The author's hospital has set policy allowing for only 1 admitted scheduled care spine surgery case per day, which has potential to have an adverse impact on wait times and care. A standard care path used in decompression surgery was adapted to accommodate more invasive mono- and bisegmental reconstructions starting in 2015 and has been followed forward comprehensively with a view to determining the success rate in managing these cases with only an overnight stay in the recovery room. **Methods:** Qualifying cases were 1- and 2-level reconstructions in ambulatory patients with supportive households to which they could be discharged. These were not minimally invasive sugeries (MIS) but classical open posterior lumbar interbody fusions (PLIFs), which can be considered as less invasive spinal surgery (LISS) procedures because dissection is limited to within the facets and so the long paraspinal musculature is not violated. The author's prospective surgical practice logs were reviewed to collect all cases treated and the success rate of next-morning discharge was determined. **Results:** Of 114 qualifying cases reviewed, 110 were primarily discharged. Two were admitted to ward beds simply because there were no overnight stay beds available. One patient who initially refused discharge was successfully supported home by a physiotherapy visit to the recovery room. Two more patients failed discharge and required admission, both for just 48 hours. There was 1 early visit to the clinic for pain control in a patient who had refused to take prescribed postoperative narcotics, 1 readmission at 2 weeks for a cerobrospinal fluid leak, and 1 later readmission for deep vein thrombosis. There were no infections. **Conclusion:** Short open PLIF reconstruction can be accomplished safely and consistently on a semiambulatory basis not requiring inpatient beds in Canada.

Presentation P10
Abstract 12
Frailty is an important predictor of 30-day morbidity in patients treated for lumbar spondylolisthesis using a posterior surgical approach: analysis of outcomes in 15 658 patients from the NSQIP database. ***Vivien Chan*****,[1,2]** ***Christopher Witiw*****,[1]** ***Michael Feblings*****.[1] From the [1]University of Toronto, Toronto, Ont.; and the [2]University of Alberta, Edmonton, Alta.**

Background: A nonoperative approach has been favoured for elderly patients with lumbar spondylolisthesis because of a perceived higher risk with surgery. However, most studies have used an arbitrary age cut-off to define "elderly." We hypothesized that frailty is an independent predictor of morbidity after surgery for lumbar spondylolisthesis. **Methods:** The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database for the years 2010 to 2018 was used. Patients who received posterior lumbar spine decompression with or without posterior fusion instrumented fusion for degenerative lumbar spondylolisthesis were included. The primary outcome was major complication. Secondary outcomes were readmission, reoperation and discharge to location other than home. Logistic regression analysis was done to investigate the association between outcomes and frailty. **Results:** There were 15 658 patients in this study. The mean age was 62.5 years (standard deviation 12.2 yr). Frailty, as measured by the 5-Item Modified Frailty Index, was significantly associated with increased risk of major complication, unplanned readmission, reoperation and nonhome discharge. Increasing frailty was associated with increasing risk of morbidity. **Conclusion:** Frailty is independently associated with higher risk of morbidity after posterior surgery in patients with lumbar spondylolisthesis. These data are of significance to clinicians in planning treatment for these patients.

Presentation P11
Abstract 13
Scoliosis flexibility correlates with postoperative outcomes following growth-friendly surgery. ***Riley Bowker*****,[1]** ***Kevin Morash*****,[1]** ***Burt Yaszay*****,[2]** ***Lindsay Andras*****,[3]** ***Peter Sturm*****,[4]** ***Paul Sponseller*****,[5]** ***Ron El-Hawary*****,[1]** ***Pediatric Spine Study Group*****.[6] From the [1]IWK Health Centre, Halifax, N.S.; the [2]Rady Children's Hospital, San Diego, Calif.; the [3]Children's Hospital Los Angeles, Torrance, Calif.; the [4]Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio; [5]Johns Hopkins University, Baltimore, Md.; and the [6]Pediatric Spine Study Group, Valley Forge, Pa.**

Background: There has been insufficient study of the relationship between preoperative flexibility and postoperative outcomes for

patients with early-onset scoliosis (EOS) who receive growth-friendly surgery (GFS). We wished to investigate this relationship to allow for improved surgical planning for EOS patients. Our objective was to determine if lower preoperative flexibility will result in less scoliosis correction and a higher risk of postoperative complications. **Methods:** The study was conducted as a retrospective review of prospectively collected study group data. EOS patients with preoperative flexibility x-rays (traction or bend) were identified. Preoperative flexibility and immediate postoperative correction were calculated for each patient. Complications were recorded. Pearson correlations were determined for flexibility versus correction for all patients and were compared between etiologies and between device types (MCGR, TGR, VEPTR). **Results:** A total of 107 patients (14 congenital, 43 neuromuscular, 31 syndromic, 19 idiopathic) with a mean age of 7.1 years at index surgery were identified. Preoperative scoliosis was 77°. Mean flexibility of 36% was not different between etiologies. Immediate postoperative scoliosis was 46° ($p < 0.05$) with mean correction of 38%. The correction rate was not different between etiologies; however, it was different between devices (MCGR 45%, TGR 40%, VEPTR 14% [$p < 0.05$]). Pearson correlation for flexibility versus correction was fair ($r = 0.37$, $p < 0.05$). This correlation was observed for idiopathic ($r = 0.53$, $p < 0.05$) and neuromuscular ($r = 0.46$, $p < 0.05$), but not for congenital or syndromic. At a mean of 4.8 years follow-up, 66 patients experienced at least 1 complication. The risk ratio for developing a complication was 1.58 (1.18–2.11) for patients with preoperative flexibility less than 30% ($p < 0.05$). **Conclusion:** Lower preoperative flexibility was associated with less scoliosis correction and a higher risk of postoperative complications in patients with EOS receiving GFS. Curve flexibility should be considered when deciding upon the timing of GFS.

Presentation P12
Abstract 14

Lumbar fusion surgery for patients with back pain and degenerative disc disease: an observational study from the Canadian Spine Outcomes and Research Network.

Nathan Evaniew,[1] Ganesh Swamy,[1] W. Bradley Jacobs,[1] Jacques Bouchard,[1] Roger Cho,[1] Neil A. Manson,[2] Y. Raja Rampersaud,[3] Jerome Paquet,[4] Christopher S. Bailey,[5] Michael Johnson,[6] Najmedden Attabib,[2] Charles G. Fisher,[7] Greg McIntosh,[8] Kenneth C. Thomas.[1] **From the [1]University of Calgary, Calgary, Alta.; the [2]Canada East Spine Centre, Saint John, N.B.; the [3]University of Toronto, Toronto, Ont.; [4]Université Laval, Québec, Que.; [5]Western University, London, Ont.; the [6]University of Manitoba, Winnipeg, Man.; the [7]University of British Columbia, Vancouver, B.C.; and the [8]Canadian Spine Outcomes and Research Network, Markdale, Ont.**

Background: Surgery for patients with back pain and degenerative disc disease is controversial, and studies to date have yielded conflicting results. We evaluated the effects of lumbar fusion surgery for patients with this indication in the Canadian Spine Outcomes and Research Network (CSORN). **Methods:** We analyzed data that were prospectively collected from consecutive patients at 11 centres between 2015 and 2019. Our primary outcome was change in patient-reported back pain at 12 months of follow-up, and our secondary outcomes were satisfaction, disability, health-related quality of life and rates of adverse events. **Results:** Among 84 patients, we observed a statistically significant improvement of back pain at 12 months that exceeded the threshold of minimum clinically important difference (MCID) (mean change –3.7 points, standard deviation [SD] 2.6, $p < 0.001$, MCID 1.2; 77% achieved MCID), and 81% reported being "somewhat" or "extremely" satisfied. We also observed improvements in scores for the Oswestry Disability Index (–17.3, SD 16.6), the 12-item Short Form Survey Physical Component Summary (10.3, SD 9.6) and the 12-item Short Form Survey Mental Component Summary (3.1, SD 8.3) (all $p < 0.001$). The overall rate of adverse events was 19%. **Conclusion:** Among a highly selective group of patients undergoing lumbar fusion surgery for degenerative disc disease, most experienced a clinically significant improvement of back pain as well as significant improvements of disability and health-related quality of life, with high satisfaction at 1 year of follow-up. These findings suggest that surgery for this indication may provide some benefit and that further research is warranted.

Presentation P13
Abstract 15

Minimally invasive versus open thoracolumbar surgery for lumbar spinal stenosis in patients with diabetes: a CSORN study.

Kalpesh Hathi,[1] Erin Bigney,[2,3] Eden Richardson,[2,3,4] Tolu Alugo,[1,5] Dana El-Mughayyar,[2] Amanda Vandewint,[2] Neil Manson,[1,2,6,7] Edward Abraham,[1,2,6,7] the CSORN Investigators,[4] Najmedden Attabib.[1,2,8] **From [1]Dalhousie Medicine New Brunswick, Saint John, N.B.; the [2]Canada East Spine Centre, Saint John, N.B.; the [3]Horizon Health Network, Saint John, N.B.; the [4]Canadian Spine Outcomes and Research Network, Markham, Ont.; the [5]Department of Anesthesiology and Pain, Saint John, N.B.; the [6]Saint John Orthopaedics, Saint John, N.B.; the [7]Depatment of Orthopedic Surgery, Saint John Regional Hospital, Saint John, N.B.; and the [8]Department of Neurosurgery, Saint John Regional Hospital, Saint John, N.B.**

Background: The objective of this study was to compare the outcomes of patients with diabetes undergoing minimally invasive surgery (MIS) versus open surgery for lumbar spinal stenosis (LSS). **Methods:** This is a multicentre retrospective cohort study using data from the Canadian Spine Outcomes and Research Network (CSORN) registry. Primary outcomes of interest were blood loss, length of stay (LOS), adverse events (AE), modified Oswestry Disability Index (ODI) score and numerical rating scales (NRS) for leg and back pain. Two analyses were run comparing MIS and open surgery for 2 cohorts: patients undergoing decompression without fusion ($n = 116$; MIS $n = 58$; open $n = 58$), and patients undergoing decompression with fusion ($n = 108$; MIS $n = 54$; open $n = 54$). Long-term outcomes were analyzed using 2 (MIS v. OPEN) by 3 (baseline, 12 wk, 12 mo) mixed measures analysis of covariance with American Society of Anesthesiologists (ASA) scores as a covariate. Categorical and continuous variables were analyzed with χ^2 tests and t tests, respectively. Significance was at p values less than 0.05 and mean differences were compared against minimal clinically important differences (MCID). **Results:** All patient groups had significant improvements in ODI and pain scores at 12 months meeting MCID. The MIS group of the

decompression with fusion cohort had significantly lower ODI scores (mean difference 14.25, $p < 0.001$) and back pain scores (mean difference 1.64, $p = 0.002$) meeting MCID 12 months after surgery compared with the open group. The MIS groups in both cohorts had significantly less blood loss (without fusion mean difference 99.77 mL, $p = 0.002$; with fusion mean difference 244.23 mL, $p < 0.001$) and LOS (without fusion mean difference 1.15 d, $p = 0.008$; with fusion mean difference 1.23 d, $p = 0.026$). MIS decompression with fusion compared with open had significantly fewer patients experiencing an AE ($p = 0.007$). **Conclusion:** Patients with diabetes benefit from surgery for LSS. To optimize outcomes, MIS approaches should be promoted for patients with diabetes undergoing decompression with fusion for LSS.

Presentation P14
Abstract 16
A successful triage system for low back pain. ***Hamilton Hall,[1] Richard Prostko,[2] Boyle Cheng,[3] Katie Haring,[4] Michael Fischer.[4]*** **From the [1]University of Toronto, Toronto, Ont.; the [2]Allegheny General Hospital, Pittsburgh, Pa.; the [3]AGN Neuroscience Institute Science, Pittsburgh, Penn.; and [4]Highmark Health, Pittsburgh, Penn.**

Background: The objective of this study was to evaluate a triage approach based on the Saskatchewan Spine Pathway classification for (a) its effect on initial management and (b) cost effectiveness. **Methods:** Between October 2017 and April 2019, the initial investigation and treatment of 260 consecutive patients with low back pain presenting to selected clinics in western Pennsylvania within the Allegheny Health Network (AHN) were first triaged and then managed based on their presenting pattern of pain (POP). The course of care was measured by (a) length of treatment, (b) number of back-related treatment visits, (c) utilization of physiotherapy, (d) amount of spinal imaging, (e) opioid use, (f) frequency of spine surgery, (g) amount of back-related, unplanned care and (h) episode cost. Subjects were compared with 256 propensity-matched controls treated for low back pain at AHN during the same period and also — for the cost analysis (because of the wide variance in the use of physiotherapy in the propensity controls) — against a matched historical control of 111 patients previously seen by the participating physiotherapists. **Results:** Treatment length was 62.2 days for the POP group and 74.5 days for the control group ($p = 0.10$). There were 1528 treatment visits for the POP group and 2046 for the control group ($p = 0.003$). Utilization of physiotherapy was 98.1% in the POP group and 45.3% in the control group ($p = 0.001$). Utilization of imaging was 24.5% in the POP group and 42.2% in the control group ($p = 0.001$). Opioid use was 4.6% in the POP group and 13.3% in the control group ($p = 0.001$). Frequency of surgery was 15.4% in the POP group and 26.2% in the control group ($p = 0.005$). Frequency of unplanned care was 1.9% in the POP group and 12.8% in the control group ($p = 0.001$). Episode cost was $1453 in the POP group and $2334 in the control group ($p = 0.005$). For the historical control, episode cost was $2799 for the POP group and $4670 for the control group. **Conclusion:** Patients triaged and managed according to their POP required less treatment time and fewer visits, had only half as many images, were prescribed significantly less narcotic, had fewer surgeries and received substantially less unplanned care. The cost saving for both propensity and historical control comparisons was approximately 40%. Giving primary care practitioners a valid, easily applicable, directive triage tool improves patient care and reduces cost.

Presentation P15
Abstract 17
Establishing normative relationship of spinopelvic alignment to femoroacetabular orientation. ***Taryn Ludwig, Jonathan Bourget-Murray, Sarup Sridharan, Ariana Frederick, Kelly Johnston, Brent Edwards, Fred Nicholls.*** **From the University of Calgary, Calgary, Alta.**

Background: Determining the native alignment of the acetabulum in patients with concomitant degenerative hip and spine pathology is challenging. In operative cases, postural changes following one surgery can influence the success of the other, and there is debate as to which procedure should be performed first. Normative data describing the relationship between hip orientation and spinopelvic alignment are not described in the literature. Our goal is to obtain 3D renderings of the spine, pelvis and hip to evaluate spinopelvic and femoroacetabular parameters in healthy young adults. We hypothesize that native femoroacetabular alignment is predictable and can be determined on the basis of measurement of spinopelvic parameters. **Methods:** This is a cross-sectional study of healthy volunteers aged 20–39 years with no known hip or spine pathology. Full-body EOS scans will be used to obtain 3D reconstructions of participants' acetabulum and proximal femur. Pelvic parameters will be measured (acetabular version and inclination, femoral version and neck shaft angle) and correlated to spinopelvic parameters (pelvic incidence, pelvic tilt, sacral slope, lumbar lordosis, lumbopelvic morphotype). A total of 450 patients have been imaged, and image processing is ongoing. Preliminary data for a subset of patients are presented here, along with descriptive statistics. Further analysis will include a predictive model of femoroacetabular alignment based on spinopelvic measurements. **Results:** A total of 172 participants are included for this abstract. Average age was 27.4 (standard deviation [SD] 4.9) years, and 65% were female. Their average spinopelvic and femoroacetabular parameters are as follows: pelvic incidence 52.7° (SD 11°), sacral slope 43.3° (SD 8.6°), pelvic tilt 9.4° (SD 7.0°), acetabular version 14.7° (SD 4.2°), acetabular inclination 55.6° (SD 3.7°), femoral version 15.8° (SD 9.3°) and femoral neck-shaft angle 130.0° (SD 4.4°). **Conclusion:** By correlating normative hip, pelvis and spine alignment, orthopedic surgeons will be able to more accurately position hip implants in patients also awaiting spinal arthrodesis, decreasing the need for revision and improving overall patient outcomes.

Presentation P16
Abstract 18
Clinical and radiographic outcomes of M6L disc arthroplasty at a single Canadian centre. ***Taryn Ludwig, Alex Soroceanu, Jacques Bouchard.*** **From the University of Calgary, Calgary, Alta.**

Background: Lumbar disc arthroplasty (LDA) is used to treat discogenic back pain. Canadian and non-industry–sponsored outcome data are limited. The objective of this study is to provide clinical and radiographic outcome data for patients receiving the M6L

prosthesis. **Methods:** An ambispective cohort study of all patients who received an M6L LDA for discogenic back pain by 1 surgeon at a tertiary centre between October 2013 and June 2019 was performed. Patients receiving single-level, dual-level or hybrid fusion/LDA procedures were included. Patient-reported outcomes at 3 months, 1 year, 2 years and 3 or more years postoperatively were obtained from the Canadian Spine Outcomes and Research Network (CSORN) database. Complication data were obtained from the CSORN database and chart review. Radiographs were assessed for global lordosis, range of motion at the arthroplasty level, displacement and subsidence. **Results:** Forty-eight single-level, 10 dual-level and 40 hybrid patients were included. Average age was 40 years, and 55% of patients were female. Length of stay in hospital was 1.5 (standard deviation [SD] 0.8) days for 1-level procedures, 1.7 (SD 0.8) days for 2-level procedures and 2.8 (SD 3.7) days for hybrid procedures. Postoperative and sustained improvements were seen in visual analogue scale (VAS) back pain ($p < 0.001$), VAS leg pain ($p < 0.001$) and Oswestry Disability Index scores ($p < 0.001$). Eighty-nine percent of single-level arthroplasty, 100% of dual-level and 96% of hybrid patients were extremely or somewhat satisfied at all follow-up times. Complication rates were similar in all groups. There were no implant-related revisions or complications. Average radiographic follow-up was 19.8 months. Lordosis and segmental range of motion were similar between groups and between pre- and post-operative imaging (9.0° ± 3.8°). **Conclusion:** Data from 1 Canadian centre demonstrate that lumbar disc arthroplasty with the M6L prosthesis is a safe procedure, with no device-related complications observed in this study. High levels of patient satisfaction and significant improvement of all measured clinical outcomes were seen.

Presentation P20
Abstract 24
Surgical intervention for patients with spinal metastasis from lung cancer: a retrospective study of 87 cases. ***Van Tri Truong, Daniel Shedid, Fidaa Al-Shakfa, Jesse Shen, Ghassan Boubez, Sung-Joo Yuh, Zhi Wang.*** **From the Centre hospitalier de l'Université de Montréal, Montreal, Que.**

Background: The objective of this study was to evaluate the prognosis and surgical outcomes of lung cancer patients with spinal metastasis undergoing surgical treatment. **Methods:** A retrospective study on a prospectively collected database was conducted. The following data were collected: age, tobacco use, tumour histology, American Spinal Cord Injury Association (ASIA) score, revised Tokuhashi score, ambulatory status, perioperative complications, postoperative adjuvant treatment and survival time. Univariate analysis and multivariate analysis were performed to identify the prognostic factors of survival. **Results:** We studied 87 patients with a mean age of 61.3 (standard deviation [SD] 1.9) years. Median survival was 4.1 (SD 0.8) months. Twenty-eight patients (32.2%) lived more than 6 months and 14 patients (16.1%) lived more than 12 months. The rate of medical complications was 13.8% and the rate of surgical complications was 5.7%. The 30-day mortality rate was 4.6%. Univariate analysis showed tobacco use, revised Tokuhashi score, preoperative and postoperative ASIA score, postoperative walking ability, postoperative radiotherapy and chemotherapy were prognostic factors. There was no significant difference in survival between adenoma lung cancers, nonadenoma lung cancers and small cell lung cancers ($p = 0.51$). Multivariate analysis revealed tobacco use, revised Tokuhashi score, postoperative walking ability, postoperative radiotherapy and postoperative chemotherapy affected survival. **Conclusion:** This is the largest reported study of lung cancer patients with spinal metastasis undergoing spinal surgery. It is the first study showing that tobacco use has a negative impact on survival. Spinal surgery improves quality of life and offers non-ambulatory patients a high chance of regaining walking ability with an acceptable risk of complications.

Presentation P22
Abstract 26
Bridging the gap between symptom onset and diagnosis in axial spondyloarthritis. ***Laura Passalent,[1] Kala Sundararajan,[1] Anthony Perruccio,[1] Peter Coyte,[2] Claire Bombardier,[2] Jeff Bloom,[1] Chris Hawke,[1] Nigil Haroon,[1] Robert Inman,[1] Y. Raja Rampersaud.[3,4]*** **From the [1]University Health Network, Toronto, Ont.; the [2]Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ont.; the [3]Schroeder Arthritis Institute, Krembil Research Institute, University Health Network, Toronto, Ont.; and the [4]Division of Orthopaedics, Department of Surgery, University Health Network, Toronto, Ont.**

Background: Inflammatory back pain can be difficult to differentiate from mechanical back pain (MBP) among primary care providers, causing delay in diagnosis of axial spondyloarthritis (axSpA). The study aim was to evaluate a stratified screening process for early identification of axSpA considering (1) wait times from primary care to rheumatology screen, (2) incremental precision and accuracy from primary care to rheumatology screen and (3) time to diagnosis. **Methods:** Adults with low back pain (LBP) attending primary care LBP clinics prospectively underwent a primary standardized clinical screen. Patients with back pain of more than 3 months duration and age of onset younger than 50 years were referred for secondary screening by a physiotherapist with advanced rheumatology training. Probability of axSpA (v. MBP) was determined at each screening level and defined as low, medium or high. Precision and accuracy of primary and secondary screens were measured against a rheumatologist with axSpA expertise. Utility of the HLA-B27 gene was assessed as an independent screen of axSpA. Sensitivity, specificity and predictive values were calculated. **Results:** In all, 405 patients underwent primary and secondary screening. Mean age was 36.9 (standard deviation 9.9) years; 55% were female. HLA-B27 was present in 14.4%. Median wait time from primary to secondary screen was 15 days. AxSpA risk assignment by rheumatologist was 64.9% (MBP or low-risk axSpA) and 35.1% (medium- or high-risk axSpA). HLA-B27 performed poorly as an independent screen with low sensitivity (28%). The best combination of sensitivity (68%), specificity (90%) and positive (80%) and negative (84%) predictive values was evident with the secondary screen. A total of 15.6% of patients received a final diagnosis of axSpA. Median LBP duration from onset to diagnosis was 2 years (non-radiographic axSpA), 7 years (ankylosing spondylitis) and 5 years (MBP). **Conclusion:** The inclusion of a secondary screening process using a stratified interprofessional model can shorten time to diagnosis with high precision and accuracy in patients with axSpA. The results of this study provide a platform to bridge the gap between onset of back pain and diagnosis.

Presentation P24
Abstract 29

Postoperative recovery patterns following discectomy surgery for lumbar radiculopathy. ***Shuaijin Wang,[1] Jeffrey Hebert,[2] Edward Abraham,[1,3,4] Amanda Vandewint,[3] Erin Bigney,[3,5] Eden Richardson,[3,5,6] Dana El-Mughayyar,[3] Najmedden Attabib,[1,3,5] the CSORN Investigators,[6] Christopher Small,[1,3,4] Neil Manson.[1,3,4]*** **From [1]Dalhousie Medicine New Brunswick, Saint John, N.B.; the [2]University of New Brunswick, Fredericton, N.B.; the [3]Canada East Spine Centre, Saint John, N.B.; [4]Saint John Orthopaedics, Saint John, N.B.; [5]Horizon Health Network, Saint John, N.B.; and the [6]Canadian Spine Outcomes and Research Network, Markham, Ont.**

Background: The objective of this study was to identify the trajectories of pain and disability in patients who underwent lumbar discectomy surgery and to investigate the construct validity of the trajectory subgroups on the basis of clinically meaningful changes. **Methods:** The study population consisted of patients with a chief complaint of lumbar radiculopathy treated with discectomy surgery from 13 enrolling sites through the Canadian Spine Outcomes and Research Network (CSORN) registry. Outcome variables of interest were the numeric rating scales for leg and back pain and modified Oswestry Disability Index scores at baseline (before surgery) and at 3, 12 and 24 months postoperatively. Group-based trajectory modelling was used to identify distinct courses of leg pain, back pain and pain-related disability. Benchmarks for minimum clinically important difference (30%) for pain and disability along with change required for clinical success in disability (reduction of 50% or Oswestry score ≤ 22) were employed in examining group differences to confirm construct validity at 12 months following surgery. **Results:** Data from 519 patients (51.2% male; mean age 47.5 ± 14.3 yr) were included in the analysis. The models revealed 3 unique trajectories for leg pain (excellent 18.4%, good 55.4%, poor 26.3%), disability (excellent 59.7%, good 35.6%, poor 4.7%) and back pain (excellent 13.0%, good 56.4%, poor 30.6%). Construct validity was supported by large differences in the proportions of patients attaining the clinical benchmarks for minimal change or success. **Conclusion:** Discectomy for lumbar radiculopathy resulted in positive recovery patterns for the majority of patients for disability outcomes (95.3%), for back pain (69.4%) and for leg pain (73.8%). It is of note that a subset of patients (26.3%–30.6%) belonged to trajectories that experienced minimal to no improvement in pain scores. Moving forward it will be important to discern the factors involved in the disconnect between the improved disability and persistence of pain for this subset of patients.

Presentation P25
Abstract 30

Effect of posture on lumbopelvic muscle morphometry and geometry in adult spinal deformity patients from upright MRI. ***Noor Shaikh,[1,2,3] Honglin Zhang,[4,5] Nick Beresford-Cleary,[5] John Street,[2,5] David Wilson,[2,3,4] Thomas Oxland.[2,3,5]*** **From the [1]School of Biomedical Engineering, University of British Columbia, Vancouver, B.C.; [2]ICORD, University of British Columbia, Vancouver, B.C.; the [3]Department of Mechanical Engineering, University of British Columbia, Vancouver, B.C.; the [4]Centre for Hip Health and Mobility, University of British Columbia, Vancouver, B.C.; and the [5]Department of Orthopaedics, University of British Columbia, Vancouver, B.C.**

Background: Adult spinal deformity (ASD) affects 60% of aging adults, with recent work highlighting the importance of lumbopelvic musculature. Currently, though, upright characteristics of lumbopelvic muscle morphometry are not well understood, and an improved understanding could inform ASD mitigation and treatment. This study's aim was to assess the effect of posture on lumbopelvic musculature and geometry in ASD patients using upright magnetic resonance imaging (MRI). **Methods:** Eight preoperative ASD patients were imaged in a 0.5-T upright MRI (MROpen, Paramed) using T1-weighted sequences in 5 postures (standing [neutral, arms unsupported, arms supported, 30° flexion], supine). Pelvic tilt (PT), pelvic incidence (PI), sacral slope (SS) and L3–S1 lumbar lordosis (LL), as well as muscle cross-sectional area [CSA], signal intensity (SI, representing fatty infiltration), radius and angle for the psoas major, multifidus/erector spinae, gluteus (maximus, medius, minimus) and iliopsoas were measured. Side-to-side parameters were classified from coronal standing clinical x-ray — concave on apex side, versus convex. Effects of posture and repeatability were evaluated by analysis of variance ($p < 0.05$) and intraclass correlation (ICC[3,1]). **Results:** Posture had significant effects/interactions on lumbopelvic parameters. From flexion to other postures, multifidus/erector spinae CSA increased up to 11% and radius increased up to 4%. For the psoas, there were effects/interactions of posture on radius/angle. Also, convex to concave, CSA (L3/L4) decreased 16%. Posture had level-dependent effects on gluteus CSA/SI/ radius and on iliopsoas CSA/radius. Standing to supine, gluteus CSA (S4/S5) increased 17%. Posture affected PT, SS and LL, but not PI. Intrarater repeatability was 0.52–0.97 (CSA) and 0.91–0.97 (geometry). **Conclusion:** This study confirms previous supine findings and highlights new postural effects and trends. Previous scoliosis studies demonstrated increased convex psoas CSA, which was also observed at L3/L4 in this study. The added posture results highlight the potential postural influences when studying ASD musculature. Promising repeatability supports the feasibility of upright imaging of lumbopelvic muscle and geometry in tandem.

Presentation P26
Abstract 33

Clinical judgment is a cornerstone for validating and using clinical prediction rules: a head-to-head study on ambulation outcomes for spinal cord injured patients. ***Rémi Pelletier-Roy,[1,2] Andréane Richard-Denis,[1,2] Stéphanie Jean,[1,3] Étienne Bourassa-Moreau,[1,2] Jean Fleury,[1,3] Geneviève Beauchamp-Vien,[2] Jean Bégin,[2] Jean-Marc Mac-Thiong.[1,2]*** **From the [1]Université de Montréal, Montreal, Que.; the [2]Hôpital du Sacré-Coeur de Montréal, Montreal, Que; and the [3]Institut de réadaptation Lindsay-Gingras, Montreal, Que.**

Background: Traumatic spinal cord injury (tSCI) is a devastating event for both patients and their relatives. Disclosure of the

functional prognosis is of paramount importance in the acute care settings. It improves medical and surgical care and increases patient adherence to treatment and rehabilitation. Patients specifically want to know if they will regain the ability to walk. A multitude of prognosis clinical prediction rules (CPR) exist, with high statistical performance reported. Surprisingly, clinicians' ability to predict ambulation outcome is unknown in the literature. Our objective is to determine clinicians' performance in predicting walking recovery after a tSCI and to compare their performance with an established CPR. **Methods:** In this retrospective comparative study of a prospective database, 6 physicians had to predict the ambulation outcome of 68 patients after a tSCI on the basis of information from the acute hospital admission. Ambulation was also predicted according to the CPR of van Middendorp (CPR-vM). The success rate of the CPR-vM and clinicians in predicting ambulation was compared using a criterion of 5% for defining clinical significance, and a level of statistical significance of 0.05 for bilateral McNemar tests. **Results:** There was no statistical difference between the overall performance of physicians (success rate of 79%) and of the CPR-vM (81%) for predicting ambulation. The differences between the CPR-vM and physicians varied clinically and significantly with the level of experience, clinical setting and field of expertise. **Conclusion:** Confronting CPRs with the judgment of a group of clinicians should be an integral part of the design and validation of CPRs. Head-to-head comparison of CPRs with clinicians is also a cornerstone of defining the optimal strategy for translation into clinical practice and of defining which clinicians and specific clinical contexts would benefit from using the CPR.

Presentation P27
Abstract 34

Sacroiliac joint pain after lumbar spine fusion for degenerative diseases: a systematic review. ***Jesse Shen,[1] Mathieu Boudier-Revéret,[2] Carl Majdalani,[3] Van Tri Truong,[2] Zhi Wang.[2]*** **From the [1]Université de Montréal, Montreal, Que; the [2]Centre hospitalier de l'Université de Montréal, Montreal, Que.; and the [3]Université de Montréal, Montreal, Que.**

Background: The objective of this systematic review was to determine the incidence of sacroiliac joint (SIJ) pain after lumbosacral spinal fusion. A secondary objective was to determine diagnostic criteria for SIJ pain and sacroiliac dysfunction. **Methods:** This review was registered in PROSPERO before commencement. A systematic search of the English literature was performed in the Medline, Embase and Cochrane Library online databases. Medical subject heading (MeSH) terms such as lumbar vertebrae, sacrum, spinal fusion, pain, sacrum, ligaments and sacroiliac joint were used for the search. Keywords such as "sacroiliac dysfunction.mp." and "sacroiliac complex. mp." were used for the search. Two independent reviewers screened all titles and abstracts for eligibility. Two independent reviewers reviewed articles to determine eligibility for final review and analysis. A third reviewer was required if there was uncertainty about eligibility. The Newcastle–Ottawa Scale was used to appraise the quality of all nonrandomized observational studies. The GRADE approach was applied to interpret the evidence and help formulate recommendations. A meta-analysis following the 2009 PRISMA work-flow and checklists will be attempted. Heterogeneity will be tested using the I^2 statistic. Subgroup analysis and testing will also be performed to explain potential heterogeneity. The a priori hypothesis is that patients with lumbar fixation extended to the sacrum have a higher incidence of SIJ pain than those without sacral fixation. **Results:** Twelve studies were included in the systematic review. All studies were observational and of moderate to low quality. The incidence of SIJ pain for patients having fusion extended to the sacrum was 9.8%. The incidence of SIJ pain for patients without fusion extending to the sacrum was 7.8%. There was high heterogeneity between studies, with an I^2 statistic of 88%. Diagnostic criteria for SI joint pain were heterogeneous. **Conclusion:** The SIJ can be a source of persistent pain after lumbar spine surgery. The current literature on SIJ pain after lumbar spine surgery is of poor quality. Patients with fusion extended to the sacrum may have a higher risk.

Presentation P28
Abstract 35

Posterior minimally invasive transpedicular approach for giant calcified thoracic disc herniation. ***Zhi Wang,[1] Daniel Shedid,[1] Ahmad Najjar,[1] Sung-Joo Yuh,[1] Ghassan Boubez,[1] Amer Sebaaly.[2]*** **From the Centre hospitalier de l'Université de Montréal, Montreal, Que.; and the [2]Hotel Dieu de France Hospital, Beirut, Lebanon.**

Background: Posterior surgery for thoracic disc herniation was associated with increased morbidity and mortality and new minimally invasive approaches have been recommended for soft disc herniation but not for calcified central disc. The objective of this study was to describe a posterolateral microscopic transpedicular approach for central thoracic disc herniation. **Methods:** This was a single-centre retrospective review of all the cases of giant thoracic calcified disc herniation as defined by Hott and colleagues. Presence of myelopathy, percentage of canal compromise, T2 hypersignal, American Spinal Cord Injury Association (ASIA) score and ambulatory status were recorded. This posterolateral technique using a tubular retractor was thoroughly described. **Results:** Eight patients were operated upon with a mean follow-up of 16 months. Mean canal compromise was 61%. Mean operative time was 228 minutes and mean operative bleeding was 250 mL. There were no cases of dural tear or neurologic degradation. **Conclusion:** This is the first report of the posterior minimally invasive transpedicular approach for giant calcified disc herniation. There were no cases of neurologic deterioration and the rate of ductal tears was not increased. This technique is thus safe and could be recommended for treatment of this rare disease.

Presentation P29
Abstract 36

A Canadian perspective on the effect of patient workload intensity on return to work after elective lumbar spine surgery. ***Supriya Singh,[1] Greg McIntosh,[2] Tamir Ailon,[1] Nicolas Dea,[1] Charles Fisher,[1] Raphaele Charest-Morin,[1] and the CSORN Investigators[3].*** **From the [1]Vancouver Spine Institute, Vancouver, B.C.; the [2]Canadian Spine Outcomes and Research Network, Toronto, Ont.; and the [3]Canadian Spine Outcomes and Research Network, Markdale, Ont.**

Background: In the Canadian population, the overall rate of return to work (RTW) after elective lumbar spine surgery is 71%. The median time to RTW is 6–8 weeks for a nonfusion procedure and 12 weeks for a fusion procedure. The objectives of this study were to determine the effects of patient workload intensity on the rate of and time to RTW after elective lumbar spine surgery. **Methods:** Using the Canadian Spine Outcomes and Research Network (CSORN) database, we performed a retrospective study of patients enrolled between January 2015 and December 2018. RTW was analyzed on the basis of workload intensity for adult patients who were employed and undergoing 1- or 2-level elective lumbar spine surgery. Workload was divided into 3 groups on the basis of daily lifting requirements: sedentary (< 10 lb), light to moderate (< 50 lb) and heavy to very heavy (> 50 lb). Additionally, 50 of 60 CSORN surgeons (83%) replied to a survey on their recommendations for RTW based on workload. **Results:** In total, 1223 patients were analyzed for RTW based on workload (496 in the sedentary group, 563 in the light–moderate group and 164 in the heavy to very heavy group). The RTW rate was 84% for the sedentary group (median 42 d), 81% for the light to moderate group (median 56 d) and 72% for the heavy to very heavy group (median 70 d). There were statistically significant differences between rates and median time to RTW for the different workload groups ($p < 0.05$). Stratified by workload, recommendations provided by the surveyed surgeons reflected the actual times to RTW. For the sedentary group, 70% of surgeons recommended RTW after 2–6 weeks for nonfusion procedures and 7–12 weeks for fusion procedures. For the light to moderate and heavy to very heavy groups, 63% recommended RTW after 7–12 weeks for nonfusion procedures and 3–6 months for fusion procedures. **Conclusion:** Sedentary, light to moderate and heavy to very heavy workers had high rates of RTW; however, workload significantly affects the rate of and time to RTW postoperatively. The majority of surgeons in our survey agreed that time to RTW should be tailored according to workload and they account for this when counselling patients.

Presentation P30
Abstract 37
Implant-related complications using uniaxial implants in pediatric spinal deformity surgery. ***Masayoshi Machida,[1] David Lebel,[1] Brett Rocos,[1] Karl Zabjek,[2] Reinhard Zeller.[1]***
From the [1]Hospital for Sick Children, Toronto, Ont.; and the [2]University of Toronto, Toronto, Ont.

Background: Innovative new spinal implants allow surgeons to treat complex pediatric spinal deformities. However, postoperative outcome might be tarnished by implant failures. To our knowledge there are no studies that investigated the clinical impact of implant-related complications on surgical outcomes using uniaxial implants, screws and hooks, in disease-specific cohorts. In this retrospective study, we evaluate the incidence of implant-related complications in pediatric spinal deformities treated with posterior spinal fusion using uniaxial implants. **Methods:** A retrospective radiographic analysis was performed on patients with pediatric spinal deformity treated with posterior spinal fusion using uniaxial implants. Postoperative radiographs were reviewed within 1 week following surgery and at final follow-up. The patients' demographic data, the number and material of implants, implant breakage and/or implant slippage were recorded. **Results:** A total of 595 patients were included (389 had a follow-up of more than 2 yr). Of these, 7 patients (1.2%) presented implant-related complications. Four patients (0.9%) with idiopathic, 1 patient (2.6%) with neuromuscular, 1 patient with congenital and 1 patient (1.2%) with syndromic scoliosis presented implant failures. Four patients required a revision surgery related to a non-union in 2 cases (rod breakage in a post-laminectomy kyphosis, screw pull-out in a syndromic scoliosis), early iliosacral screw pull-out in a neuromuscular scoliosis, and iliac screw breakage 2 years after a lumbosacral fusion in a congenital scoliosis. Incidental x-ray findings without modification of the clinical and radiographic outcome were 1 case of transverse connector breakage and 2 cases of hook slippage. **Conclusion:** The overall rate of implant-related complications was 1.2%, with a revision rate of 0.7%. Implant failure due to non-union happened in 0.5% of our patients. These data are useful for the preoperative discussion about risks and benefits of a posterior spinal fusion in pediatric spinal deformities.

Presentation P31
Abstract 38
Increased upper thoracic curve vertebral rotation is associated with shoulder imbalance after posterior spinal fusion for adolescent idiopathic scoliosis. ***Masayoshi Machida,[1] Karl Zabjek,[2] Brett Rocos,[1] David Lebel,[1] Reinhard Zeller.[1]***
From the [1]Hospital for Sick Children, Toronto, Ont.; and the [2]University of Toronto, Toronto, Ont.

Background: Residual shoulder imbalance is associated with suboptimal outcomes following the surgical correction of scoliosis including a higher risk of decompensation and poor cosmetic satisfaction. In this retrospective study, we evaluate the radiographic parameters and the relationship between the global and local indices of spinal alignment with shoulder balance preoperatively and postoperatively using EOS imaging. **Methods:** A retrospective radiographic analysis was performed on patients with adolescent idiopathic scoliosis, treated with posterior spinal fusion. Postoperative radiographs were obtained immediately following surgery, at 6 months and at final follow-up over 2 years postoperatively. Radiographic evaluation included measurement of radiographic shoulder height difference (RSHD) and radiographic parameters including apical vertebral rotation (AVR). **Results:** A total of 66 patients were included (63 females). RSHD averaged 14 (standard deviation [SD] 14) mm preoperatively, –15 (SD 12) mm immediately after surgery, –8.5 mm (SD 11) mm at 6 months and –8.3 (SD 8.7) mm at final follow-up, respectively. Analysis revealed a significant correlation between proximal thoracic (PT) Cobb angle at all postoperative periods and RSHD at final follow-up. Significant correlations were further observed between PT AVR at all postoperative periods and RSHD at final follow-up, and between main thoracic (MT) AVR at 6 months postoperatively and RSHD at final follow-up ($r > 0.20$, $p < 0.05$). Applying the Lenke classification, there were significant correlations between RSHD at final follow-up and PT AVR at final follow-up in Lenke type 1, and between RSHD at final follow-up and PT AVR at all postoperative periods in Lenke type 3. **Conclusion:** The significant correlations presented in this study suggest that PT Cobb angle, PT and MT AVR are associated with shoulder imbalance. PT AVR showed the strongest correlation with shoulder imbalance in Lenke type 1 and 3.

Presentation P32
Abstract 40
Biomechanical evaluation of a C1–C2 posterior arch screw construct. ***Renan Fernandes,[1,2] Aaron Gee,[1] Nicole Schneider,[1,2] Andrew Kanawati,[1,2,3] Emil Schemitsch,[1,2] Chris Bailey,[1,2] Parham Rasoulinejad,[1,2] Radovan Zdero.[1,2]*** **From the [1]London Health Sciences Centre, London, Ont.; [2]Western University, London, Ont.; and [3]Westmead Hospital, Sydney, New South Wales, Australia.**

Background: The objective of this study was to evaluate and compare the biomechanics of a C1–C2 posterior arch screw construct against the Harms procedure for posterior atlantoaxial fixation on a human cadaveric model. **Methods:** Nine fresh frozen human cadaveric cervical specimens from occiput to C3 (C0–C3) (8 male and 1 female; mean age 66.6 yr) were used for range of motion (ROM) testing. Each specimen was tested for 4 configurations: (1) intact, (2) destabilized, (3) C1–C2 posterior arch screw (PAS) construct and (4) Harms construct. Matched pair comparison was performed for the 2 constructs. A pure moment of 1.5 Nm was applied for each test. The ROM of the C1–C2 segment was measured in flexion–extension, lateral bending and axial rotation. The 2 surgical constructs were compared between the groups and with the intact and destabilized condition. **Results:** Harms and PAS groups had significantly increased stability when compared with the destabilized condition for flexion–extension, lateral bending and axial rotation ($p < 0.003$). In flexion–extension, the Harms group showed a significant increase in stability when compared with the intact condition ($p = 0.033$), while the PAS group did not ($p = 0.1.0$). In lateral bending, the Harms and PAS group did not show a significant difference in stability compared with the intact condition ($p > 0.33$). In axial rotation, the Harms and PAS group showed a significant increase in stability when compared with the intact condition ($p < 0.001$). There was no significant difference in stability when comparing Harms with PAS in flexion–extension (p = 0.96), lateral bending ($p = 0.51$) or axial rotation ($p = 1.0$). **Conclusion:** The study demonstrates that a C1–C2 PAS construct is able to restore or increase biomechanical stability compared with the intact condition. C1–C2 PAS offers similar biomechanical stability as the Harms construct. C1–C2 PAS may be used as a salvage method or a less invasive alternative to C1 lateral mass screws and C2 pedicle screws during atlantoaxial fixation.

Presentation P33
Abstract 41
Accuracy of patient-specific drill guides for C1 and C2 laminar screw placement. ***Renan Fernandes,[1,2] Nicole Schneider,[1,2] Aaron Gee,[1] Andrew Kanawati,[1,2,3] Radovan Zdero,[1,2] Chris Bailey,[1,2] Parham Rasoulinejad.[1,2]*** **From the [1]London Health Sciences Centre, London, Ont.; [2]Western University, London, Ont.; and [3]Westmead Hospital, Sydney, New South Wales, Australia.**

Background: The objective of this study was to evaluate the accuracy of using patient-specific drill guides to place bilateral laminar screws in C1 and C2. **Methods:** Nine fresh cervical specimens (8 male and 1 female; mean age 66.6 yr) with the occiput attached (C0–C3) were used in this study. Preoperative computed tomographic (CT) scans were performed to create digital models of the anatomy for templating and guide creation. A total of 36 screws were placed with the aid of 3-dimensional (3D) printed patient-specific guides (2 laminar screws at C1 and C2). Postoperative CT scans were performed following screw insertion. The planned and actual trajectory was compared using preoperative and postoperative imaging based on the angular and entry point deviation. After screw placement and postoperative imaging each specimen was dissected and a visual inspection for breaches was performed. **Results:** After postoperative CT scans, no cortical bone breaches were identified on the actual trajectory. During visual inspection, no breaches could be assessed on C1 screws, and no violations were observed in C2 laminas. The overall average variation of the entry point in the x, y, and z axis was 0.3 (standard deviation [SD] 0.28), 0.41 (SD 0.38) and 0.29 (SD 0.24,) respectively. No statistically significant difference ($p > 0.005$) was observed between the planned and the obtained entry points. There was no significant difference ($p > 0.05$) in the deviation analysis between the planned and the obtained angles in the axial and coronal planes. **Conclusion:** The study demonstrates that patient-specific drill guides allow for accurate C1 and C2 bilateral laminar screw placement, with a low risk of cortical breach. C1 and C2 translaminar screws may be used not just as a salvage method but also as a less invasive alternative arrangement to C1 lateral mass screws and C2 pedicle screws during the atlantoaxial spine fixation.

Presentation P34
Abstract 42
Diagnosic and treatment criteria of craniocervical instability in Ehlers–Danlos syndrome: a systematic review. ***Nandan Marathe, Laura-Nanna Lohkamp, Michael Feblings.*** **From Toronto Western Hospital, Toronto, Ont.**

Background: Treatment indications for craniocervical instability (CCI) in patients with Ehlers–Danlos syndrome (EDS) remain a matter of debate resulting in inconsistent surgical care. The aim of this systematic review is to summarize the diagnostic and therapeutic criteria currently applied in EDS and to identify consecutive knowledge gaps. **Methods:** A systematic literature review was performed on the basis of PRISMA guidelines. Articles were included if they described the application of diagnostic or treatment criteria or both for CCI in the context of EDS. Reported parameters pertaining to CCI and treatment indication in EDS patients are summarized. **Results:** Out of 113 articles, 7 met the inclusion criteria. Overall, 13 distinct linear and angular morphometric parameters of CCI were recorded and applied according to the type of instability. The choice of diagnostic parameters was inconsistent among the majority of articles. Consistent treatment criteria were proposed in 2 of the studies, including a total of 42 EDS patients, who underwent cervical instrumentation for CCI. Reported symptoms representing treatment indications were neurologic deficits, headache and neck pain or symptoms of cervicomedullary syndrome combined with radiographic signs of instability. Statistically significant improvement of headache or neck pain as well as of symptoms related to cervicomedullary syndrome were documented in most of the patients in both studies. **Conclusion:** On the basis of the current literature, there is a significant lack of evidence for the choice and correct application of CCI criteria in EDS patients. The parameters mainly used are the atlantoaxial

interval (ADI), basion-axial interval (BAI), clivo-axial angle (CXA) and angular displacement between C1 and C2, but further assessment in bigger cohorts is warranted. Published outcome data after craniocervical instrumentation in these patients are scarce and univocal, although positive, not yet able to guide us in surgical decision-making. Further studies are required to evaluate a set of dedicated diagnostic criteria and to establish clinical guidelines for craniocervical instrumentation.

Presentation P35
Abstract 43

Paediatric health-related quality of life outcomes following surgery for adolescent idiopathic scoliosis. ***Jack Kerr,[1] Edward Abraham,[2–4] Amanda Vandewint,[3] Erin Bigney,[3,5] Jeffrey Hebert,[6] Eden Richardson,[3,5,7] Dana El-Mughayyar,[3] Jill Chorney,[8,9] Ron El-Hawary,[10] PORSCHE Study Group,[11–17] Neil Manson.[2,3,4]*** **From the [1]Faculty of Medicine, Memorial University of Newfoundland, St. John's, Nfld.; the [2]Department of Surgery, Dalhousie Medicine New Brunswick, Saint John, N.B.; the [3]Canada East Spine Centre, Saint John, N.B.; [4]Saint John Orthopaedics, Saint John, N.B.; [5]Horizon Health Network, Saint John, N.B.; the [6]Faculty of Kinesiology, University of New Brunswick, Fredericton, N.B.; the [7]Canadian Spine Outcomes and Research Network, Markham, Ont.; the [8]Mental Health and Addictions Program, IWK Health Centre, Halifax, N.S.; the [9]Department of Psychiatry, Dalhousie University, Halifax, N.S.; the [10]Department of Surgery, IWK Health Centre, Halifax, N.S.; [11]McGill University, Montreal, Que.; [12]Stollery Children's Hospital, Edmonton, Alta.; the [13]University of Alberta, Edmonton, Alta.; [14]McMaster University, Hamilton, Ont.; [15]Alberta Children's Hospital, Calgary, Alta.; [16]Children's Hospital of Eastern Ontario, Ottawa, Ont.; and the [17]Ste. Justine Hospital, Montreal, Que.**

Background: The purpose of this study was to identify patient trajectories of recovery defined by change in health-related quality of life (HRQOL) following surgery for adolescent idiopathic scoliosis (AIS). **Methods:** Adolescent patients (aged 10 to 20 yr) scheduled to undergo posterior spinal fusion for AIS were enrolled in the Postoperative Recovery following Spinal Correction: Home Experience (PORSCHE) study. Responses to the Pediatric Quality of Life Inventory version 4 (PedsQL 4.0) were collected before surgery and 4–6 weeks, 3 months, 6 months and 12 months postoperatively. Group-based trajectory modelling was used to identify unique subgroups of physical health (PH) and psychosocial health (PSH) outcomes using the PedsQL 4.0 summary scores. **Results:** Data from 190 patients were analyzed (86.5% female; mean 14.6 [standard deviation (SD) 1.9] yr). Three trajectory subgroups were identified for PH: moderate start, minor decline, high finish 19.3%; high start, moderate decline, high finish 26.1%; and high start, major decline, high finish 54.5%. Four trajectories were found for PSH: high start, high finish 42.9%; high–moderate start, high finish 26.1%; moderate start, high finish 17.5%; and moderate start, moderate finish 13.4%. **Conclusion:** The majority of patients scored within the established range of healthy adolescents for PH (mean score 84.41 [SD 17.26]) and PSH (mean score 82.38 [SD 15.51]) 12 months following surgery. However, PSH was only affected by surgery for a small subset of patients (17.5%).

Presentation P36
Abstract 46

The standardization of postoperative analgesic prescriptions to reduce opioid use in outpatient spine surgical procedures. ***Marie-Claude Magnan,[1,2] Eugene Wai,[1–3] Philippe Phan,[1–3] Stephen Kingwell,[1–3] Sarah Tierney,[1–3] Alexandra Stratton.[1–3]*** **From the [1]The Ottawa Hospital, Ottawa, Ont.; the [2]University of Ottawa, Ottawa, Ont.; and the [3]Ottawa Hospital Research Institute, Ottawa, Ont.**

Background: Reconciling adequate pain control perioperatively while mitigating the risks related to prescription opioid analgesia is pivotal to successful surgical outcomes. Prescribing opioids after day surgery is common practice; however, there are many inherent risks including dependency, diversion and medical complications. Our study investigates the effect of a standardized analgesic prescription on the amount of opioids prescribed and patients' satisfaction with pain control in the early postoperative period. **Methods:** With the implementation of a new electronic medical record, a patient education handout and standardized prescription was built employing multimodal analgesia and a stepwise approach to analgesics based on level of pain. Consecutive patients over a 3-month period undergoing elective spine surgery as a day case or overnight stay who received usual care were compared with a similar cohort who received the standardized prescription and education. Patient satisfaction with postoperative pain control, refills required and opioids prescribed in oral morphine equivalents (OMEs) were compared before and after the implementation of the standardized analgesic prescription. **Results:** Twenty-six patients received usual care (control group) and 26 patients received the standardized prescription and education handout (intervention group). There were significantly less OMEs prescribed of tramadol and other opioids in the intervention group compared with the control group. There was no difference between groups in patient satisfaction or number of refills required. **Conclusion:** This study demonstrates that a standardized prescription consisting of an appropriate amount of opioid and nonopioid analgesics with patient education is effective in reducing opioids prescribed following relatively minor spine surgical procedures. It is a practical intervention for spine surgeons to employ to mitigate the effect of prescribed opioids in fuelling the opioid epidemic.

Presentation P38
Abstract 50

A CSORN study: comparison between primary and revision lumbar decompression outcomes. ***Samantha Visva,[1,2] Abdullah AlDuwaisan,[1–3] Dita Moravek,[2,3] Eugene Wai,[1–3] Stephen Kingwell,[1–3] Alexandra Stratton,[1–3] Philippe Phan,[1–3] and the CSORN Investigators.[4]*** **From the [1]Faculty of Medicine, University of Ottawa, Ottawa, Ont.; the [2]Ottawa Hospital Research Institute, Ottawa, Ont.; the [3]Department of Surgery, The Ottawa Hospital, Ottawa, Ont.; and the [4]Canadian Spine Outcomes and Research Network, Markdale, Ont.**

Background: Revision spinal surgeries confer clinical benefit but are not without risk, including increased susceptibility to complications and adverse events compared with primary surgeries. To date, few studies have compared primary and revision decompression to quantify a difference in health status. Of these

studies, none used a large database to extrapolate their results using minimal clinically important differences (MCID), and outcome measures of patient satisfaction were significantly limited. The objective of this study is to compare the quality of life (QOL) and satisfaction outcomes between primary and revision lumbar decompressive patients using the Canadian Spine Outcomes and Research Network (CSORN). **Methods:** Primary and revision lumbar discectomy (LD) and laminectomy/laminotomy (LLL) patient data were collected from CSORN. Improvements in the Oswestry Disability Index (ODI), EQ-5D and SF-12 physical and mental component score (PCS and MCS) from baseline to 1-year follow-up were compared with their respective MCIDs. Primary versus revision improvement at 1-year follow-up was compared using mean differences. **Results:** Follow-up data for 1054 primary (513 LD, 541 LLL) and 66 revision (20 LD, 46 LLL) cases were identified. At baseline, age and comorbidities per patient were significantly different between primary and revision groups. Satisfaction among both revision LD and LLL patients was greater than among primary patients (revision: 90% LD, 93.4% LLL; primary: 86.6% LD, 87.3 LLL; LD $p = 0.69$, LLL $p = 0.048$). The mean differences in QOL measures between primary and revision patients were as follows: ODI (LD: –13.264, $p = 0.005$; LLL: –7.936, $p < 0.001$), EQ-5D (LD: 0.22386, $p < 0.001$; LLL: 0.08452, $p = 0.004$), SF-12 PCS (LD: 4.29589, $p = 0.039$; LLL: 3.04754, $p = 0.007$) and SF-12 MCS (LD: 2.96466, $p = 0.22$; LLL: 1.92994, $p = 0.18$). **Conclusion:** This study indicates that revision lumbar decompression yields greater satisfaction but poorer QOL outcome improvements compared with primary surgery. Surgical outcome expectations may play a role in patient satisfaction, and further study on the matter is warranted.

Presentation P39
Abstract 53
Patient factors affecting hospital length of stay for adolescent idiopathic scoliosis patients undergoing posterior spinal instrumentation and fusion in a rapid recovery protocol. ***James Jarvis,*[1,2] *Zachary Devries,*[1,2] *Nick Barrowman,*[1,2] *Kevin Smit,*[1,2] *Andrew Tice.*[1,2] **From the [1]Children's Hospital of Eastern Ontario, Ottawa, Ont.; and the [2]University of Ottawa, Ottawa, Ont.**

Background: Rapid recovery pathways (RRP) reduce hospital length of stay (LOS) for adolescent idiopathic scoliosis (AIS) patients undergoing posterior spinal instrumentation and fusion (PSIF). Although most patients are discharged in 3 days, some require longer admissions. The goal of this project was to determine which pre- and peri-operative factors prolong hospital LOS for AIS patients in a RRP. **Methods:** All patients undergoing PSIF for AIS and enrolled in a RRP at a tertiary children's hospital between March 2015 and August 2020 were included in the analysis. Patients were excluded if they experienced an intraoperative complication, experienced an immediate postoperative complication or had a diagnosis other than AIS. Pre- and peri-operative factors were collected. Spearman correlations were used to determine the factors most associated with hospital LOS and those factors were used in a multivariable regression model. **Results:** A total of 161 patients were included in the analysis. Preoperative factors that significantly correlated with LOS included a large thoracic Cobb angle ($\rho = 0.18$; $p = 0.023$) and American Society of Anesthesiologists (ASA) status ($\rho = 0.16$, $p = 0.046$). Correlating intraoperative factors included fusion of both the thoracic and lumbar spine ($\rho = 0.18$, $p = 0.025$) and receiving a blood transfusion ($\rho = 0.24$; $p = 0.002$). Perioperative factors included receiving celecoxib on postoperative day 1 ($\rho = -0.16$; $p = 0.038$). All variables were significant predictors of hospital LOS ($R^2 = 0.088$; $p = 0.014$). Using multivariable regression, the factor that had the greatest association with LOS was receiving a blood transfusion (B 0.49, 95% confidence interval 0.096–0.89; $p = 0.015$). **Conclusion:** In this study, it was found that receiving a blood transfusion in the perioperative period was the greatest predictor of LOS for AIS patients in a RRP. Other factors included large thoracic curve, greater ASA status and fusion of both the thoracic and lumbar spine. As RRPs become increasingly used in centres performing PSIF it is important to identify those factors that can lead to prolonged hospital stay to better prepare the surgical team.

Presentation P40
Abstract 56
Comparison of factors associated with prolonged hospital length of stay for adolescent idiopathic patients undergoing posterior spinal instrumentation and fusion in Canada and the United States. ***James Jarvis,*[1,2] *Zachary Devries,*[1,2] *Nick Barrowman,*[1,2] *Kevin Smit,*[1,2] *Andrew Tice.*[1,2] **From the [1]Children's Hospital of Eastern Ontario, Ottawa, Ont.; and the [2]University of Ottawa, Ottawa, Ont.**

Background: Previous studies have identified specific pre- and peri-operative factors associated with prolonged hospital length of stay (LOS) for adolescent idiopathic scoliosis (AIS) patients undergoing posterior spinal instrumentation and fusion (PSIF) following a rapid recovery pathway (RRP). However, these studies have all been conducted in the United States. There are no studies investigating whether these factors are transferable to Canada. The goal of this study was to determine if similar factors apply for patients in a single-payer universal health care system, such as Canada. **Methods:** Patients from a single, tertiary referral children's hospital in Canada were used. Patient inclusion and exclusion criteria were the same as those used in the previous studies. Factors included female sex, surgical time, levels fused, receiving a blood transfusion, average pain score on the first postoperative day, and morphine use on postoperative day 1. Spearman correlations and multivariable regression analyses were used to assess the factors association with LOS. **Results:** A total of 161 patients were included in the analysis. The only common, significantly correlated, variable was receiving a postoperative transfusion ($\rho = 0.24$; $p = 0.002$). None of the other preidentified variables were found to be significant. Variables not previously examined but significantly correlated were a large thoracic curve ($\rho = 0.18$; $p = 0.023$), American Society of Anesthesiologists (ASA) status ($\rho = 0.16$, $p = 0.046$), fusion involving both the thoracic and lumbar spine ($\rho = 0.18$, $p = 0.025$) and receiving celecoxib on postoperative day 1 ($\rho = -0.16$; $p = 0.038$). Using multivariable regression, the factor that had the greatest association with LOS was receiving a blood transfusion (B 0.49, 95% confidence interval 0.096–0.89; $p = 0.015$). **Conclusion:** Those factors associated with

prolonged hospital stay in the United States are not transferable to Canada. Factors found to be significantly associated with prolonged LOS in Canada are large thoracic curve, greater ASA status, receiving a blood transfusion and fusion of both the thoracic and lumbar spine. This is the first study to identify this difference between the health care systems.

Presentation P42
Abstract 58
The clinical course of symptoms during wait time for lumbar spinal stenosis surgery and its effect on postoperative outcome: a retrospective cohort study. ***Thorsten Jentzsch,*[1,2] *Kala Sundararajan,*[3] *Y. Raja Rampersaud.*[1,3] **From the [1]Toronto Western Hospital, University Health Network, University of Toronto, Toronto, Ont.; [2]Balgrist University Hospital; University of Zurich, Zurich, Switzerland; and the [3]Krembil Research Institute; University Health Network, Toronto, Ont.**

Background: The objective of this study was to evaluate the effect of wait times on postoperative outcome in patients and on the clinical course while awaiting surgery for lumbar spinal stenosis. **Methods:** In this retrospective cohort study, a convenience sample was drawn from prospective longitudinal studies that provided preoperative Oswestry Disability Index (ODI) data at 2 different time points and follow-up of 12 or more months. Wait time was the period between the date of the initial consultation and immediately preoperatively. It was categorized into 2 different time points (short [< 6 v. ≥ 6 mo] and long [< 12 v. ≥ 12 mo]). The primary outcome was the ODI minimal clinically important difference (MCID) (< 30% v. ≥ 30% improvement) at 1 year. Multivariate analysis adjusted for age and surgery type. **Results:** A total of 134 patients were analyzed. The median age was 69.0 (interquartile range [IQR] 14.0) years, 66 (49.3%) were female, 89 (66.4%) underwent decompression and 45 (33.6%) underwent additional instrumented fusion. The median wait time was 5.9 (IQR 8.2) months and the postoperative follow-up was 19.2 (IQR 8.1) months. Wait time was not associated with absolute postoperative change in ODI scores, but patients with wait times less than 12 months were significantly more likely to reach the ODI MCID at last follow-up (66 [73.3%] for < 12 mo v. 13 [46.4%] for ≥ 12 mo, p = 0.008; odds ratio 0.29, 95% confidence interval 0.12–0.75, p = 0.011). During surgical wait, there was no difference in patients deteriorating above the MCID for each time point (10 [9.7%] v. 5 [16.1%], p = 0.32). **Conclusion:** Although longer wait times do not appear to negatively influence postoperative outcome in patients with lumbar spinal stenosis using absolute values, longer waits may potentially affect individual patients' ability to achieve MCID. Patient-reported pain-related disability from the initial surgical consultation to surgery is relatively stable in most patients for at least 6–12 months.

Presentation P43
Abstract 61
Lumbar shortening: a novel surgical technique for lumbosacral fusion following total sacrectomy. ***Ahmed Cherry,*[1] *Colby Oitment,*[2] *Jay Wunder,*[1,3] *Peter Ferguson,*[1,3] *Raja Rampersaud.*[1,4] **From the [1]University of Toronto, Toronto, Ont.; [2]McMaster University, Hamilton, Ont.; the [3]University Health Network, Mount Sinai Hospital, Toronto, Ont.; and the [4]University Health Network, Toronto Western Hospital, Toronto, Ont.**

Background: Reconstruction after total sacrectomy is challenging with a high risk of failure. In this report, we describe the outcome of a novel technique following sacrectomy whereby the L5 vertebra is lowered into the pelvis and the posterior pelvic ring is closed onto the native L5 vertebra. **Methods:** We conducted a retrospective chart review of hospital records for 2 patients treated by a single surgeon in our institution. Chart review included patient demographics, clinical assessments, complications, pathology and imaging reports. **Results:** Owing to the involvement of the presacral bowel, patients underwent a multidisciplinary 2-stage procedure that included a pelvic exenteration with colostomy in both patients, and ileal conduit in 1 patient, at the first stage followed by posterior wide margin total sacral resection and instrumentation. The first patient was a 17-year-old male who presented with lumbosacral neuropathic pain and radiculopathy after a failed intralesional surgery and radiation for chondrosarcoma. The second patient was a 51-year-old male who presented with chronic low back pain caused by a large low-grade chondroid sacral chordoma. In both cases reconstruction involved lowering the remaining L5 vertebra into the pelvis and lumbopelvic instrumentation to obtain host bone-to-bone contact under compression, eliminating the need for vascularized bone grafts. In addition to planned resection neurologic deficits, both patients had temporary L4 myotomal weakness with recovery over 2 years. The first patient required irrigation and débridement procedures for a deep pelvic infection and chronic suppressive antibiotic therapy. The second patient's postoperative course was complicated by superficial abdominal wound drainage, lower limb deep vein thrombosis, pulmonary emboli and an aspiration pneumonia. Postoperative computed tomography (CT) scans showed solid bony fusion at 3 years and 18 months, respectively. Both patients were doing well, with no evidence of tumour recurrence, at 7 and 2 years' follow-up, respectively. **Conclusion:** Primary lumbar shortening represents a novel technique for structural spinopelvic reconstruction following total sacrectomy that obviates the additional morbidity and prolonged operative time required for vascularized fibula grafting.

Presentation P44
Abstract 62
The use of minimally invasive navigation guided resection of spinal osteoid osteomas and osteoblastomas. ***Ahmed Cherry,*[1] *Raja Rampersaud.*[1,2] **From the [1]University of Toronto, Toronto, Ont.; and the [2]University Health Network, Toronto Western Hospital, Toronto, Ont.**

Background: Osteoid osteomas (OO) and osteoblastomas (OB) are benign bone lesions that typically involve the posterior elements. Owing to anatomic location, they are often not amenable to radiofrequency ablation (RFA). Complete intralesional resection of the nidus has been shown to be curative; however, it often requires instrumented spinal fusion. In this study, we sought to demonstrate the feasibility and efficacy of outpatient minimally invasive, navigation-assisted, anatomy-preserving resection for treatment of symptomatic

spinal OOs and OBs. **Methods:** We conducted a retrospective chart review of 6 patients treated by a single surgeon in our institution between 2018 and 2020. The chart review included patient demographics, preoperative clinical assessments, treatment complications and follow-up clinical outcomes. Indication for operative intervention was a confirmed lesion on preoperative computed tomography (CT) with clinical symptoms in keeping with OO or OB. **Results:** The patient cohort consisted of 3 males and 3 females with an average age of 25.4 years. All 6 patients reported axial spine pain that was worse at night, with stiffness and radiculopathy noted in 2 patients. Symptom duration ranged from 9 to 72 months. Preoperative CT identified lesions localized to the articular facet (3), vertebral body (2) and sacral body (1). Two patients had previous failed RFA. Average operative time was 99.2 (range 65–154) minutes, with no patients requiring instrumentation or admission. There were no reported perioperative complications and all had resolution of their primary back-focused pain at the first 6-week postoperative follow-up. Three patients reported subjective lumbar stiffness. One patient exhibited S1/S2 paresthesias immediate postoperatively with resolution at 6 weeks. One patient was found to have questionable recurrence of nidus on CT 7 months postoperatively. He reported only mild back stiffness with resolution of preoperative symptoms. No patients had significant changes to alignment or stability identified on postoperative x-rays. **Conclusion:** In this report, outpatient navigation-guided minimally invasive targeted resection without fusion is a feasible and effective treatment in the short term for symptomatic spinal OO and OB.

Presentation P45
Abstract 63
Survival following revision en-bloc resection after intralesional index procedure for primary malignant spinal tumours. ***Ahmed Cherry*,[1] *Raja Rampersaud*.[1,2] From the [1]University of Toronto, Toronto, Ont.; and the [2]University Health Network, Toronto Western Hospital, Toronto, Ont.**

Background: Negative margin en-bloc resection of primary malignant tumours involving the spine is the recommended treatment to provide patients with the best odds of long-term disease-free survival. In addition to higher recurrence and a poorer survival rate, an index intralesional procedure (IIP) creates additional challenges for achieving a margin negative revision resection. In this report, we describe the outcomes for 10 patients who underwent revision resection with en-bloc intent following IIPs for primary malignant spinal tumours. **Methods:** We conducted a retrospective chart review of 10 patients who underwent IIPs. The chart review included patient demographics, clinical assessments, complications and operating room, pathology and imaging reports. **Results:** Average patient age was 36.6 years; there were 7 males and 3 females. Seventy percent of IIPs occurred in Ontario academic institutions. Indication of IIP included presentation to the emergency department with neurologic deficit from cord (4) or cauda equina compression (1); radiculopathy (3); myelopathy (1); and dysphagia (1). Index pathology included 2 osteosarcoma; 2 Ewing sarcoma, 2 chondrosarcoma, 1 chordoma, 1 spindle-cell sarcoma; 1 leiomyosarcoma and 1 sclerosing epithelioid fibrosarcoma. Before revision, 1 patient underwent neoadjuvant chemotherapy, 3 underwent radiotherapy and 4 underwent combined treatment. A potentially positive dural margin was planned in 8 patients and a wide resection in 2. Five patients required multistaged procedures. The resection margins were negative in 9 patients. Sixty percent had perioperative adverse events, with 3 requiring a return to the operating room. Fifty percent had late complications including nonunion with rod breakage, allograft resorption, screw loosening, junctional kyphosis and an esophageal erosion. At final follow-up (mean 6.8 yr) 2 patient died of early metastasis (Ewing sarcoma) and 1 had local recurrence at 7 years and again at 4 years after return to the operating room (margin-positive chordoma). The leiomyosarcoma patient is clinically well; however, no recent follow-up imaging is available. The remaining 7 patients are disease free at a mean of 8.1 years. **Conclusion:** In highly selected patients, revision en-bloc resection for malignant primary spinal tumours after inappropriate index intralesional surgery is achievable with good long-term outcomes.

Presentation P46
Abstract 64
Impact of COVID-19 on surgical outcomes: international multidisciplinary study. ***Charlotte Dandurand*, *Tamir Ailon*, *Marcel Dvorak*, *Brian Kwon*, *Scott Paquette*, *Raphael Charest-Morin*, *Nicolas Dea*, *Charles Fisher*, *John Street*. From the University of British Columbia, Vancouver, B.C.**

Background: The World Health Organization declared a pandemic on Mar. 11, 2020, because SARS-CoV-2 (the virus that causes COVID-19) was affecting most countries. Patients undergoing surgery are a vulnerable group who may be particularly susceptible to both infection with COVID-19 and related pulmonary complications. The goal of this prospective international multidisciplinary observational study (CovidSurg) is to determine the outcomes of elective and emergency surgery, including adult spinal surgery, performed during the COVID-19 pandemic. **Methods:** All consecutive patients who underwent spinal surgery between Oct. 20 and Oct. 27, 2020, at a single quaternary spinal care centre were included in this phase of the study. Demographics, region of residence, procedure, postoperative complications and COVID-19 testing status were collected. Predetermined postoperative pneumonia, unexpected ventilation, acute respiratory distress syndrome (ARDS) and pulmonary emboli were identified. Other postoperative complications were classified using the Clavien–Dindo classification. At our study centre, a preoperative COVID-19 questionnaire is used to classify patients as green (low risk), yellow (intermediate risk) and red (high risk or positive). **Results:** In the initial phase of the CovidSurg study, 1128 patients who contracted COVID-19 postoperatively were identified across 24 countries. Pulmonary complications occurred in 51.2% (577/1128) of patients. For this subset of the study, the catchment population weekly incidence of COVID-19 was 30 cases per 100 000, with a cumulative incidence of 371 per 100,000, and a test positivity rate of 4.6%. A total of 16 patients underwent spinal surgery from Oct. 20 to Oct. 27. Three patients underwent emergency surgery. On the basis of symptom screening, 2 patients required a COVID-19 test in the postoperative period and both results were negative. No predetermined COVID-19 pulmonary

adverse events were identified. One patient had delirium. One patient had urinary retention. One patient had a urinary tract infection. One patient had wound leakage. **Conclusion:** This preliminary report is on data from the first of 6 nonconsecutive weeks of this international multidisciplinary study assessing the impact of COVID-19 on surgical outcomes. The additional 5 weeks will be completed and the data will be analyzed before the Canadian Spine Society annual meeting. Surgical activity and outcomes will be compared with those in the same periods in previous prepandemic years.

Presentation P47
Abstract 65

Decompression versus decompression and fusion for "stable" degenerative spondylolisthesis: a randomized clinical trial. ***Raja Rampersaud,[1,2] Chris Bailey,[3] Steve Casha,[4] Andrew Glennie,[5] Richard Fox,[6] Greg McIntosh,[7] Albert Yee,[8] Charles Fisher,[9] Anthony Perruccio.[1]*** **From the [1]Schroeder Arthritis Institute, Krembil Research Institute, University Health Network, Toronto, Ont.; the [2]Division of Orthopaedics, Department of Surgery, University Health Network, Toronto, Ont.; the [3]London Health Sciences Centre and Western University, London, Ont.; the [4]Foothills Medical Centre and University of Calgary, Calgary, Alta.; the [5]QEII Health Sciences Centre and Dalhousie University, Halifax, N.S.; the [6]Mackenzie Health Sciences Centre and University of Alberta Hospital, Edmonton, Alta.; the [7]Canadian Spine Outcomes and Research Network, Toronto, Ont.; the [8]Sunnybrook Health Sciences Centre, Toronto, Ont.; and the [9]Vancouver General Hospital and University of British Columbia, Vancouver, B.C.**

Background: There is growing evidence that fusion is not required in all degenerative spondylolisthesis (DS) surgery patients. However, criteria for who should and should not be fused remain lacking. The purpose of this study was to compare 1-year patient-reported outcomes (PROs) following decompression versus decompression and fusion in DS patients with predefined preoperative clinical and radiographic criteria. **Methods:** A multicentre, randomized clinical trial was conducted at 7 Canadian Spine Outcomes and Research Network (CSORN) sites. A composite a priori definition of "stable" DS patients was used for enrollment (1–2 level lumbar spinal stenosis; neurogenic claudication with leg greater than or equal to back pain symptoms; < 50% listhesis; dynamic movement of < 5 mm of translation on flexion/extension radiographs or magnetic resonance imaging [MRI] or computed tomography [CT] to standing radiograph; neutral or lordotic DS disc; and < 10° scoliosis without evidence of rotatory or lateral listhesis on standing x-rays). Computer-generated randomization was used. Standard univariate statistical analyses of baseline as well as follow-up categorical and continuous variables were performed with SPSS. **Results:** Forty-eight of 70 enrolled patients (69%) were eligible for this analysis. Twenty-four patients underwent fusion (50%). One-year PROs were available for 39 of 48 patients (81%; 19 fusions). There were no significant baseline demographic, clinical or PRO differences between groups. Decompression alone was associated ($p < 0.001$) with shorter operative time (–65 min), less blood loss (–285 mL) and shorter length of stay (–2 d). Perioperative adverse events were not significantly different. One-year change for decompression versus fusion was similar for our primary PRO (Oswestry Disability Index score: –24.6 v. –21.8) and all secondary PROs (back pain: –4.9 v. –3.5; leg pain: –5.7 v. –4.7; SF-12 physical component score: 13.6 v. 11.1; and EQ-5D score: 0.22 v. 0.23). Similar outcomes were seen also at 3 months ($n = 45$). **Conclusion:** From this preliminary report, fusion does not appear to confer benefit over decompression alone for patients meeting the defined composite clinical and radiographic criteria of "stable" DS put forth in this study.

Presentation P48
Abstract 66

Factors associated with risk of persistent disabling back pain: results from an interprofessional low back pain program. ***Kala Sundararajan,[1,2] Anthony Perruccio,[2–4] Y. Raja Rampersaud.[1,2,4]*** **From the [1]Division of Orthopaedics, Department of Surgery, University Health Network, Toronto, Ont.; the [2]Schroeder Arthritis Institute, Krembil Research Institute, University Health Network, Toronto, Ont.; the [3]Dalla Lana School of Public Health, University of Toronto, Toronto, Ont.; and the [4]Department of Surgery, University of Toronto, Toronto, Ont.**

Background: Interprofessional models of care that provide education and self-management support to patients with chronic low back pain (LBP) have been shown to reduce costs while achieving high patient satisfaction, but their participants' long-term outcomes are not well established. The objectives of this study were to identify (1) factors associated with risk of persistent disabling back pain (PDBP) before and after intake from primary care to an interprofessional program for chronic LBP and (2) factors that predict improvement in risk of PDBP. **Methods:** Prospective study participants from the LBP program completed intake and 6-month follow-up questionnaires on demographic, health and LBP-related measures, including the Keele STarT Back Screening Tool, which classified respondents as being at low, moderate or high risk of PDBP. For the first objective, risk groups were compared on a variety of factors. For the second objective, the sample was limited to participants with moderate or high risk at intake; among this group, bivariate and multivariable analyses were used to identify factors associated with improvement to low risk at follow-up. **Results:** The sample included 1330 participants who completed intake and follow-up questionnaires (mean age 53 yr, 58% female). At intake, 40% were classified as being at low risk, 38% as being at moderate risk and 22% as being at high risk of PDBP. Increased risk was consistently associated with worse physical and mental health and increased pain and disability. Six months after intake, the proportions of patients at low, moderate and high risk were 67%, 21% and 12%, respectively. Among participants who had a moderate or high risk at intake, 53% improved to low risk and 47% remained at increased risk at follow-up. Controlling for multiple factors, improvement in PDBP risk was predicted by male sex, shorter pain duration, nonsmoking, lower baseline disability, higher self-efficacy and moderate versus high baseline risk. **Conclusion:** Chronic LBP patients can achieve substantial improvement in PDBP risk in an integrated interprofessional LBP program providing active education and self-management support. Further benefit may be achieved by targeting modifiable factors such as smoking and self-efficacy.

Patients with the highest PDBP risk may need additional supports to attain adequate improvement.

Presentation P49
Abstract 67
Assessment of the impact of early manifestations of spasticity on long-term functional recovery following spinal cord injury. ***Annie Levasseur,*[1,2] *Jean-Marc Mac-Thiong,*[1,3,4] *Andréane Richard-Denis.*[1,5,6] **From the [1]Research centre, Centre intégré universitaire de santé et services sociaux du Nord-de-l'Île-de-Montréal, Hôpital du Sacré-Coeur de Montréal, Montreal, Que.; the [2]University of Montreal, Montreal, Que.; the [3]Department of Surgery, Centre intégré universitaire de santé et services sociaux du Nord-de-l'Île-de-Montréal, Hôpital du Sacré-Coeur de Montréal, Montreal, Que.; the [4]Department of Surgery, University of Montreal, Montreal, Que.; the [5]Department of Physical Medicine and Rehabilitation, Centre intégré universitaire de santé et services sociaux du Nord-de-l'Île-de-Montréal, Hôpital du Sacré-Coeur de Montréal, Montreal, Que.; and the [6]Department of Medicine, University of Montréal, Montréal, Que.**

Background: Approximately 80% of individuals with spinal cord injuries (SCI) experience manifestation of spasticity such as spasms, clonus and hypertonia. While the occurrence of spasticity is generally reported after the first month following SCI, recent evidence rather suggests that a substantial proportion (63%) of individuals present spastic signs within the early acute phase following the injury. The impact the different manifestations of spasticity could have on recovery after a SCI and the influence of the timing of their manifestation remain issues of concern. Therefore, the objective of this study was to investigate the relationship between the development of different signs and symptoms of spasticity during acute care hospital admission on functional recovery, 6 to 12 months after SCI. **Methods:** A retrospective analysis was performed on a cohort of 161 patients admitted for traumatic SCI to a specialized trauma facility. Comparative analysis was performed to determine the characteristics of individuals who manifest early signs and symptoms of spasticity during the acute care hospital admission. Correlations were performed to determine the relationship between the manifestation of spasticity and the Spinal Cord Independence Measure (SCIM) scores collected between 6 and 12 months after injury. Correlations were also performed to determine the specific impact of early clonus, hypertonia and/or muscle spasms on functional recovery. **Results:** Individuals with at least 1 sign of early spasticity showed significantly lower total SCIM score and sub-scores at follow-up compared with individuals without early spasticity ($p < 0.05$). The development of spasms was the only clinical manifestation of early spasticity related to the total SCIM score and 3 subscores at follow-up, with a moderate correlation coefficient ($r = –0.4$). After adjusting for their respective confounding factors, the occurrence of spasms was only significantly associated with a decreased mobility at follow-up ($r = –0.17$). **Conclusion:** The development of early signs and symptoms of spasticity, in particular the occurrence of spasms during acute care, may be associated with decreased functional outcome and mobility following SCI. Early assessment of spasticity following SCI is thus recommended.

Presentation P50
Abstract 68
Biomechanical comparison of subsidence between patient-specific and non-patient-specific PLIF cages. ***Renan Fernandes,*[1] *Aaron Gee,*[1] *Andrew Kanawati,*[1,2] *Parham Rasoulinejad,*[1] *Radovan Zdero,*[1] *Christopher Bailey.*[1] **From the [1]London Health Sciences Centre, London, Ont.; and the [2]Westmead Hospital, Sydney, New South Wales, Australia.**

Background: Instrumented lumbar spinal fusion procedures have grown over the last century, and the use of interbody fusion devices is well established. Among several techniques, posterior lumbar interbody fusion (PLIF) has become 1 of the most popular. Biomechanical studies comparing cage shapes and sizes have found substantial differences when increasing the surface of contact with larger devices. Still, none of them have specifically focused on the effect of a patient-specific intervertebral disc device. Thus far, no biomechanical studies have compared stiffness and loading distribution parameters using PLIF implants that match the end plate bone geometry versus flat surface commercial PLIF cages. **Methods:** After obtaining computed tomographic scan images of the lumbar spine of cadaveric specimens, we performed a 3-dimensional (3D) volumetric reconstruction sequence. From the vertebrae's 3D model, PLIF cages matching the end plate geometry were obtained through a Boolean operation. The cages were printed using a resin with properties similar to PEEK. Biomechanical testing was performed on the cadaveric lumbar vertebrae, comparing the patient-specific (PS) cages to 2 commercially available cages (Fuse and Capstone (Medtronic Sofamor Danek USA). The force required for mechanical failure (in N) and stiffness (in N/mm) was compared among the groups. **Results:** In the first comparison group, PS cages were compared with Fuse cages. The mean force to failure was 1399 N for PS caged and 852 N for Fuse cages ($p < 0.001$). The mean stiffness was 1274 N/mm and 431 N/mm ($p < 0.001$). In the second comparison group, PS cages were compared with Capstone cages. The mean force to failure was 1381 N for PS cages and 1164 N for Capstone cages ($p = 0.086$). The mean stiffness was 1382 N/mm and 867 N/mm ($p = 0.009$). **Conclusion:** Interbody fusion implants matching the end plate surface can help prevent subsidence because they require a higher force to subside, and they present a significantly higher stiffness than commercially available cages.

Presentation P51
Abstract 69
Does the impaction of morcellized bone graft prevent interbody fusion device subsidence? ***Renan Fernandes,*[1] *Aaron Gee,*[1] *Andrew Kanawati,*[1,2] *Parham Rasoulinejad,*[1] *Radovan Zdero,*[1] *Christopher Bailey.*[1] **From the [1]London Health Sciences Centre, London, Ont.; and the [2]Westmead Hospital, Sydney, New South Wales, Australia.**

Background: Several strategies to improve the surface of contact between the device and the end plate have been employed to attenuate the risk of cage subsidence. Although most cages present an open space to house morcellized bone graft to increase fusion rates, there is no published study so far exploring the contribution of the graft to prevent subsidence. Thus, we proposed to (1) investigate the role of the hand-packed graft in the prevention of subsidence and (2) determine if the morcellized bone graft

can be compressed to the point that provides mechanical support to minimize cage subsidence. **Methods:** A titanium mesh cage was compressed over polyurethane foam blocks. Four constructs were used to compare the role of the bone graft in the prevention of subsidence. The first group had no graft and served as the control group (CG). In the second group, the graft was hand packed (low force group [LG]). In the third group, the graft was packed to 100 N (intermediate force group [IG]). In the last group, the graft was packed to 800 N (high force group [HG]). The force required for a 3-mm subsidence (in N) and the stiffness (in N/mm) were compared among the groups. **Results:** For clinically relevant subsidence (3 mm), the average force was 597 N in the CG, 588 N in the LG, 751 N in the IG and 888 N in the HG. Post-hoc analysis showed a statistically significant difference among all the constructs except between CG and LG. Mean stiffness was 0.182 N/mm for the CG, 0.181 N/mm for the LG, 0.241 N/mm for the IG and 0.314 N/mm for the HG. There was no difference in stiffness between CG and LG, but it was statistically significant between the other constructs ($p < 0.001$). **Conclusion:** Although it has been shown that the compression of the bone graft by hand does not help in the prevention of subsidence, the impaction of the graft to greater forces can play an essential role in the prevention of subsidence.

Presentation P52
Abstract 71

Quantitative imaging derived metrics of sarcopenia applied to prostrate cancer. ***Kelly Fullerton,[1] Geoff Klein,[1] Urban Emmenegger,[2,3] Joel Finkelstein,[4] Frank Lyons,[5,6] Cari Whyne,[1,4] Michael Hardisty.[1,4]*** **From the [1]Physical Sciences Platform, Sunnybrook Research Institute, Toronto, Ont.; the [2]Odette Cancer Centre, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont.; the [3]Biological Sciences Platform, Sunnybrook Research Institute, Toronto, Ont.; the [4]Department of Surgery, University of Toronto, Toronto, Ont.; the [5]Department of Orthopaedic Surgery, Mater University Hospital, Dublin, Ireland; and the [6]School of Medicine, University College, Dublin, Ireland.**

Background: Highly prevalent in cancer patients, sarcopenia is a generalized and progressive loss of skeletal muscle mass, which is strongly correlated with surgical complications and mortality. Existing methods of quantifying sarcopenia involve labour-intensive manual segmentation of 2-dimensional (2D) computed tomography (CT) slices or semiautomated methods prone to inaccuracy. Metastasis to the spine is common in patients with cancer (especially prostate), which increases the clinical impact of sarcopenia in this population. The goal of this work is to develop a reliable tool for rapid, sensitive 3D quantification of sarcopenia, applying results to improve prostate cancer care. **Methods:** This preliminary retrospective study proposes a deep learning algorithm, specifically a 3D U-Net convolutional neural network (CNN) for segmenting the psoas muscle between the L2/3 and L4/5 intervertebral discs in routine CTs. The algorithm was designed to be robust for common imaging perturbations, including resolution, psoas size and positioning. The data set used to develop the algorithm was taken from 32 patients with initial and 1-year follow-up imaging, with 26 volumes used for training and 6 used for validation. The model's predicted 3D volumes were evaluated against their manually contoured scans using a dice similarity coefficient (DSC) and compared with existing manual 2D segmentations. **Results:** The model yielded a DSC of 89.4% in the training set, and 84% in the validation set before thresholding, which improved to 89% with thresholding. It took an average of 0.175 s to segment the psoas muscle. We found a linear relationship with the established manual 2D method ($R^2 = 0.93$, $p < 0.001$). **Conclusion:** Rapid automated psoas segmentation enables future study of large data sets to understand sarcopenia progression using routine prostate cancer CTs. The developed deep learning approach was found to yield fast, accurate 3D quantification of sarcopenia, with potential for greater sensitivity to small muscle changes found with 2D analyses. Integration of this method into a clinical tool will allow accurate and robust quantitative sarcopenia assessments that could direct research into better treatments and improve patient outcomes.

Presentation P53
Abstract 72

Facilitated decompression in anterior cervical corpectomy and fusion (ACCF) and anterior cervical discectomy and fusion (ACDF) procedures using a new curved bone removal device. ***Hani Malone,[1] Michael Millgram,[2] Richard Guyer,[3] Ran Harel,[4] Ely Ashkenazi.[2]*** **From the [1]Scripps Clinic Torrey Pines, La Jolla, Calif.; the [2]Assuta Hospital, Tel Aviv, Israel; the [3]Texas Back Institute, Plano, Tex.; and the [4]Sheba Medical Center, Ramat Gan, Israel.**

Background: Cervical fusion, such as anterior cervical corpectomy and fusion (ACCF) and anterior cervical discectomy and fusion (ACDF) procedures, is commonly performed to address cervical spinal stenosis and its resultant myelopathy. Spinal osteophytes pressuring adjacent neural structures can cause pain and neurologic symptoms and may require surgical removal. Compressive osteophytes on the posterior aspect of the vertebral body are hard to access and their removal may lead to neurologic complications because of their proximity to neural structures. This study describes the authors' experience with a new shielded angulated drilling device designed to safely remove osteophytes during ACCF and ACDF procedures. The device is used following a corpectomy or discectomy to drill into the osteophytes, in parallel to the thecal sac and anterior to the posterior longitudinal ligament. The use of this device results in a smaller and safer decompression and can reduce the need for additional vertebral body resection, thus preserving spinal stability. **Methods:** Data were collected from 38 ACCF procedures and 11 ACDF procedures conducted using the device. Procedure time, blood loss, length of stay, numerical pain scores and SF-36 questionnaire scores were retrieved from patient records where available. **Results:** All procedures were uneventful, without neurologic deterioration and major complications. Decompression ability, as verified by intraoperative O-arm computed tomography (CT) imaging, was satisfactory. The average ACCF and ACDF surgery durations were 78 and 61 minutes, respectively. The average hospital admission durations were 3.4 and 3 days. Average patient back and arm pain scores were both improved by 1.4. SF-36 scores were improved in all domains. **Conclusion:** The presented device enabled safe and efficient removal of osteophytes in ACCF and ACDF procedures.

Presentation P54
Abstract 73

Spinal injury in mountain bikers: an updated British

Columbia perspective. ***Chris Daly,[1,2] Marcel Dvorak,[1] Charles Fisher,[1] Scott Paquette,[1] John Street,[1] Nicolas Dea,[1] Tamir Ailon,[1] Raphaele Charest-Morin,[1] Brian Kwon.[1]*** **From the [1]Vancouver General Hospital, Vancouver Spine Surgery Institute, Vancouver, B.C.; and [2]Griffith University, Gold Coast, Queensland, Australia.**

Background: Mountain biking has dramatically increased in popularity since its inception as a sport in North America in the 1970s. With its mountains and climate, British Columbia is extremely popular with the mountain biking community. With the rise in popularity of mountain biking the incidence of patients admitted to Vancouver General Hospital (VGH) for treatment of associated spine and spinal cord injuries anecdotally appears to have increased. After spine and spinal cord injuries related to mountain biking were initially described in 2010, the objective of this paper is to provide an updated quantification and characterization of the epidemiology of spinal injuries related to off-road mountain biking in British Columbia. **Methods:** A retrospective review of data prospectively collected in institutional spine injury registries will be performed on all patients admitted to VGH with spine or spinal cord injury related to off-road mountain biking from 2008 to 2019. Analysis will include demographic data, injury details, treatment, outcome, resource requirements and discharge destination. **Results:** The study will detail the demographic data, injury characterization, treatment, outcome and discharge destination. Injury characterization will include classification of injury type and American Spinal Injury Association Impairment Scale (AIS) score. Treatment will detail whether nonoperative or operative management was pursued and the nature of such management. Outcome will include long-term AIS score and discharge destination (i.e., home, rehabilitation facility or long-term care facility). **Conclusion:** Spine fractures and spinal cord injuries caused by mountain biking accidents continue to typically affect young, male recreational riders. The increasing popularity of this sport has seen an anecdotal increase in the incidence of spine and spinal cord injury admissions to VGH related to off-road mountain biking. Given the medical, personal and societal costs of these injuries, further research and education efforts are necessary to reduce the risks associated with this endeavour.

Presentation P55
Abstract 74

Improved efficacy and reduced hospital admission cost of TLIF procedures due to the use of a dedicated device for disc space preparation. ***John Peloza,[1] Michael Millgram,[2] Richard Guyer,[3] Jean-Charles Le Huec,[4] Ely Ashkenazi.[2]*** **From the [1]Center for Spine Care, Dallas, Tex,; the [2]Israel Spine Center, Assuta Medical Center, Tel Aviv, Israel; the [3]Texas Back Institute, Plano, Tex.; and the [4]Bordeaux University Hospital, Bordeaux, France.**

Background: Transforaminal lumbar interbody fusion (TLIF) procedures are commonly performed, posing a financial burden on patients, hospitals and insurers. Reducing procedure cost, while maintaining efficacy, may be assisted by a new powered device, designed to clean the end plates for improved cartilage removal and shorten the time required for disc removal. This retrospective study aims to assess the changes in clinical, operative and economic parameters in TLIF procedures resulting from the use of the device in a single hospital. **Methods:** The records of 208 single-level TLIF procedures conducted in a single hospital during 2012–2019 were reviewed: 143 procedures were conducted using the device and 65 control procedures were conducted using traditional tools. Clinical outcome was assessed using pain and disability scores. The cost per unit of different components affecting the overall cost was derived from the literature, online resources and the hospital's financial department and used to estimate the overall cost changes. **Results:** The analysis revealed a statistically significant reduction of 23 minutes in surgery duration after controlling for procedure year and patient characteristics ($p < 0.001$). In addition, the device group had a shorter average length of stay (0.44 d, $p = 0.5$), fewer complications (2.8% v. 6.2%, $p = 0.21$) and readmissions (2.1% v. 3.1%, $p = 0.67$) and fewer patient complaints about postoperative leg pain or weakness (2.8% v. 9.2%, $p = 0.04$). Pain and disability scores were significantly improved as a result of the procedure, without a significant difference between both groups. Revision surgery rates due to incomplete disc removal or pseudarthrosis were similar in the 2 groups (1.5% and 1.4%, $p = 0.94$). Overall, the improvements led to a statistically significant cost reduction of approximately $2000 ($p < 0.01$), which is considerably higher than the device's listed price. **Conclusion:** The study suggests that use of the device can lead to a shorter procedure and reduced costs and potentially also reducd complication rates, without deteriorating the clinical outcome.

Presentation P56
Abstract 75

Safe cervical tumour removal using a curved bone removal instrument. ***John Peloza,[1] Michael Millgram,[2] Richard Guyer,[3] Ran Harel,[4] Scott Kutz,[5] Ely Ashkenazi.[2]*** **From the [1]Center for Spine Care, Dallas, Tex.; the [2]Israel Spine Center, Assuta Medical Center, Tel Aviv, Israel; the [3]Texas Back Institute, Plano, Tex.; the [4]Sheba Medical Center, Ramat Gan, Israel; and [5]Minimally Invasive Neurosurgery of Texas, Plano, Tex.**

Background: Surgical treatments to the upper cervical levels hold the risk of substantial complications because of their proximity to vital blood vessels, nerves and the esophagus. The dimensions and shape of surgical tools, such as the straight high-speed drill, dictate the required access route to the treated region. To avoid unsafe approaches and to facilitate a safer access route to the tumour, the surgeon may choose to drill through healthy tissues. However, the removal of supporting bone structures may lead to spinal instability and require spinal fusion, thus complicating patient recovery. A recently developed device offers a potential solution to this problem. A curved-tip drilling device allows the surgeon to reach difficult-to-access areas with minimal bone removal. The use of this device is demonstrated here in a tumour resection procedure. **Methods:** A 62-year-old male without prior spine surgeries was operated for an anterior cervical discectomy and fusion (ACDF) procedure on the C5–C6 vertebrae. A C2 vertebral tumour was observed in the preoperative imaging scans. The tumour's location at the anterior part of the vertebra and its proximity to neural structures complicated its surgical removal using traditional tools and required extensive removal of healthy tissue. However, during the ACDF procedure the surgeon noticed an opportunity to safely remove

the tumour using the curved device with minimal damage to healthy tissues and through the same incision. **Results:** The procedure was uneventful and without complications. The tumour removal using the device required 2 minutes. The operation length was 63 minutes and the estimated blood loss was 200 mL. Histopathologic examination revealed characteristic eosinophilic granuloma. The patient was admitted to hospital for 5 days and released without further complaints. **Conclusion:** The curved bone removal device facilitated a safe, quick and efficient removal of the vertebral tumour without removal of healthy surrounding tissues, thus sparing the patient from potential spinal instability.

Presentation P58
Abstract 77
International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI): use in acute care. ***Kristen Walden,[1] Jessica Parsons,[1] Christopher S. Bailey,[2,3] Perry Dhaliwal,[4] Daryl R. Fourney,[5] Vanessa Noonan,[1,6] Jean-Marc Mac-Thiong.[7]*** **From the [1]Praxis Spinal Cord Institute, Vancouver, B.C.; the [2]London Health Sciences Centre, London, Ont.; the [3]University of Western Ontario, London, Ont.; the [4]University of Manitoba, Winnipeg, Man.; the [5]University of Saskatchewan, Saskatoon, Sask.; the [6]University of British Columbia, Vancouver, B.C.; and the [7]Université de Montréal, Montreal, Que.**

Background: The International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) are the international standards to determine the level and severity of neurologic injury following spinal cord injury (SCI). ISNCSCI exams inform clinical management, prognostication and research. However, their use clinically is unknown. The objective of this work was to determine ISNCSCI implementation in acute hospitals and examine injury and care factors that affect completion. **Methods:** A review of patients enrolled in the Rick Hansen SCI Registry (RHSCIR) at acute hospitals (n = 16) and discharged between Jan. 1, 2018, and Dec. 31, 2019, was conducted. Data analyzed included ISNCSCI use within 7 days of admission (ISNCSCI documentation), completion (motor, sensory, anorectal scores, neurologic level of injury [NLI] and ASIA Impairment Scale [AIS] completed) and accuracy (mismatch rates between clinically determined NLI and AIS versus calculated by the Praxis ISNCSCI algorithm). All RHSCIR sites received ISNCSCI training and ongoing support as required. Additional ISNCSCI exams during acute care, impact of surgery (e.g., preoperative and postoperative use), admission to intensive care, presence of multitrauma and impacts of concomitant injuries (e.g., brain injury) will be examined. **Results:** A total of 797 patients were included. ISNCSCI documentation ranged between 56% and 75% of all eligible patients for 9 sites and between 76% and 92% for 7 sites. ISNCSCI completion ranged between 12% and 50% for 5 sites, between 51% and 75% for 5 sites and between 76% and 100% for 6 sites. For all complete and partial exams, the mismatch in NLI or AIS or both ranged between 4% and 15% for 9 sites, between 16% and 30% for 4 sites and between 31% and 57% for 3 sites. Additional ISNCSCI use and the effect of injury and care factors will be reported as well as details on the ISNCSCI exam accuracy rates. **Conclusion:** There are variations in ISNCSCI documentation, completion and accuracy rates across RHSCIR acute hospitals. Further exploration of injury and care factors and areas of mismatch is needed to inform implementation strategies and improve ISNCSCI use, given that it is an international SCI standard of care.

Presentation P59
Abstract 78
MOBI (My Orthopedic Brace Inventory): a new, reliable and valid questionnaire to identify factors associated with poor adherence to brace treatment in AIS. ***Omar Elsemin,[1] Marie Beausejour,[2,3] Samuel Sassine,[1] Julie Joncas,[3] Soraya Barchi,[3] Sylvie Le May,[1,3] Nikita Cobetto,[3,4] Carole Fortin,[1,3] Aubin Carl-Éric,[3,4] Stefan Parent,[1,3] Hubert Labelle.[1,3]*** **From the [1]Université de Montréal, Montreal, Que.; the [2]Université de Sherbrooke, Sherbrooke, Que.; the [3]Centre hospitalier universitaire Sainte-Justine, Montreal, Que.; and [5]Polytechnique Montréal, Montreal, Que.**

Background: The BrAIST study reported a correlation between the number of hours of brace wear and the effectiveness of brace treatment in adolescent idiopathic scoliosis (AIS). Unfortunately, poor adherence to brace wear was also documented, for causes that remain to be identified. We aimed to develop and validate a questionnaire focusing on brace adherence that could help to identify causes of poor bracing wear in AIS. **Methods:** This was a psychometric validation protocol. On the basis of the conceptual framework of the World Health Organization, we developed a 34-item questionnaire covering 7 domains: physical, emotional, functional and social wellbeing, and barriers to enrollment related to the patient, treatment and health system. Content validity was established through triangulation of a thorough literature review, results from a patient focus group and a Delphi process with health professionals. Usability was confirmed in a pre-test. The questionnaire was then administered to 128 AIS patients undergoing brace treatment with a compliance monitor. MOBI scale distribution, test–retest reliability, internal consistency and discriminant capacity were tested. **Results:** A total of 53% of patients were considered as adherent to treatment by wearing their brace as prescribed (≥ 16 h/d). MOBI's global score successfully discriminated between adherent and nonadherent patients (p = 0.001). Patients with a curve > 40° had a significantly higher MOBI score (p = 0.04). The mean global score was 44.2 (standard deviation 17.4, range 11.0–94.0) (over a maximum of 132; lower scale indicating a better outcome). The score distribution showed no significant floor or ceiling effect on the conceptual domains, but 3 items showed a ceiling effect. Internal consistency was excellent (Cronbach α 0.89). Test–retest reliability (40 patients) was adequate (33 items with good or moderate interclass coefficients; ICC > 0.5). **Conclusion:** The MOBI self-administered questionnaire documents reliably and validly for the first time the factors associated with poor brace adherence in AIS. After cross-cultural adaptation in various languages, MOBI will be distributed freely to the spine community to help assess factors associated with poor adherence and design strategies to improve brace wear.

Presentation P61
Abstract 82
Development and validation of an objective version of the

degenerative lumbar spondylolisthesis instability classification (DSIC) scheme. ***Mark A. MacLean,[1] Chris Bailey,[2] Charles Fisher,[3] Raja Rampersaud,[4] Andrew Glennie.[1]*** **From [1]Dalhousie University, Halifax, N.S.; the [2]University of Western Ontario, London, Ont.; the [3]University of British Columbia, Vancouver, B.C.; and the [4]University of Toronto, Toronto, Ont.**

Background: The degenerative spondylolisthesis instability classification (DSIC) system categorizes 3 different types of degenerative lumbar spondylolisthesis (DLS) (stable, potentially unstable and unstable). Surgeons consider various determinants of stability and the system suggests a corresponding procedure. There are no objective criteria for each clinical characteristic or radiographic parameter. The first objective of this study was to generate a quantitative (objective) version of the DSIC system. The second objective was to compare qualitative surgeon-based scores and the quantitative values calculated from the patient radiographic and clinical data. **Methods:** The following 5 parameters were included in the quantitative DSIC system: presence of facet effusion, absence of disc height loss (> 6.5 mm), translation (> 4 mm), kyphotic or neutral disc angle on flexion radiographs, and presence of low back pain (LBP) (> 5/10 intensity). Scores ranging from 0 to 5 were converted to DSIC stability types and surgical procedures were assigned: 0–2 points (stable; decompression only), 3 points (potentially unstable; decompression, posterolateral fusion), 4–5 points (unstable; posterior interbody fusion). Quantitatively selected procedures were compared with qualitatively selected (actual) procedures per patient. **Results:** Quantitative DSIC scores were calculated for 309 Canadian Spine Outcomes and Research Network (CSORN) registry patients. Qualitatively, there were 92 (30%) stable, 164 (53%) potentially unstable and 53 (17%) unstable patients. Quantitatively there were 176 (57%) stable, 106 (34%) potentially unstable and 27 (9%) unstable patients. Surgeons qualitatively assigned higher degrees of instability in 130 patients (42%). Data for actual procedure received were available for 263 patients. A more invasive surgical procedure was performed than what was objectively recommended in 116 patients (44%). **Conclusion:** Surgeons are more likely to categorize greater degrees of instability than what is objectively justified. This had a substantial impact on resource utilization within this patient cohort, where almost half of patients received more invasive surgery than was potentially warranted. Future validation work is required.

Presentation P62
Abstract 83

Exploring the ability of radiographic parameters of stenosis severity to predict patient recovery patterns. ***Johnathan Rose,[1] Neil Manson,[1–3] Erin Bigney,[2,4] Amanda Vandewint,[2] Jeffrey Hebert,[5] Dana El-Mughayyar,[2] Eden Richardson,[2,4,6] Nora Ghallab,[2] Meghan Flood,[1] Najmedden Attabib,[1,2,4] the CSORN Investigators,[6] Edward Abraham.[1–3]*** **From [1]Dalhousie Medicine New Brunswick, Saint John, N.B.; the [2]Canada East Spine Centre, Saint John, N.B.; [3]Saint John Orthopaedics, Saint John, N.B.; [4]Horizon Health Network, Saint John, N.B.; the [5]Universty of New Brunswick, Fredericton, N.B.; and the [6]Canadian Spine Outcomes and Research Network, Markham, Ont.**

Background: The objective of this study was to explore the relations between preoperative imaging findings and postoperative trajectories of pain and disability following surgery for lumbar spinal stenosis (LSS). **Methods:** Patients in the Canadian Spine Outcomes and Research Network (CSORN) registry with LSS were included. A previous publication classified these patients into excellent, good or poor recovery trajectories on the basis of leg pain, back pain and disability. The numerical rating scale (NRS) for leg pain and back pain and the modified Oswestry Disability Index were used. Outcomes were collected at baseline and at 3, 12 and 24 months after surgery. Preoperative magnetic resonance imaging (MRI) images from a single site (n = 258) were measured for spinal canal cross-sectional area (CSA), degree of central stenosis (CS) and foraminal stenosis (FS). Multinomial models reporting risk ratios (RRs) were used to examine the risk of experiencing a good or poor outcome relative to an excellent outcome. **Results:** Patients with severe CS had a 73% reduced risk (RR 0.27, 95% confidence interval [CI] 0.08–0.89) of belonging to the subgroup with poor leg pain. For back pain, patients with severe CS had a 75% reduced risk (RR 0.25, 95% CI 0.09–0.74) of belonging to the good recovery subgroup and a 68% reduced risk (RR 0.32, 95% CI 0.11–0.94) of belonging to the poor recovery subgroup. For disability, patients with severe CS had a 69% reduced risk (RR 0.31, 95% CI 0.13–0.72) of having a good recovery as opposed to belonging to the subgroup with excellent recovery. Patients with moderate FS showed a 3.4-fold increased risk (RR 3.4, 95% CI 1.2–9.9) of belonging to the subgroup with a good recovery pattern for leg pain instead of an excellent recovery pattern. Degree of FS was not associated with back pain or disability subgroup membership. CSA was not significant for any outcome of interest. **Conclusion:** Preoperative imaging findings may help to predict clinical outcomes with LSS surgery. Patients with a higher grade of CS may benefit more from surgery than those with mild CS. Conversely, patients with a lower grade of FS may experience a better surgical outcome for leg pain.

Presentation P64
Abstract 87

Is the incidence of PJF and PJK declining over time? A 10-year study of the Calgary Deformity Database. ***Marcelo Oppermann, Ganesh Swamy, Fred Nicholls, Ken Thomas, W. Bradley Jacobs, Alex Soroceanu, Nathan Evaniew.*** **From the University of Calgary, Calgary, Alta.**

Background: Spinal deformity is highly prevalent in older individuals, affecting between 32% and 68% of that population. While surgery improves quality of life, the complication rate remains high, particularly proximal junctional fracture (PJF) and kyphosis (PJK). Reported postoperative PJK rates following adult spinal deformity surgery range as high as 20%–40%, but recent studies registered smaller values. We hypothesize that PJK and PJF rates are declining over time because of better surgical techniques. **Methods:** We created the Calgary Spine Deformity Database, including patients operated upon between 2008 and 2018, with more than 3 levels (including L5) and a minimum 2-year follow-up. Revision surgeries due to PJK and PJF were identified. We grouped the patients into 3 discrete time periods according to broad

technical patterns: 2008–2010 (posterior-based surgery), 2010–2015 (direct lateral interbody fusions [DLIFs] plus L5–S1 transforaminal lumbar interbody fusion [TLIF] with or without osteotomies) and 2015–2018 (DLIFs plus L5–S1 oblique lumbar interbody fusion [OLIF] with or without osteotomies). We analyzed the annual incidence and the surgical factors at the index surgery that could change the PJK/PFJ rate, including UIV, intervertebral spacers, osteotomies, vertebroplasty and ligamentoplasty. χ^2 testing was used for statistical analysis. **Results:** We included 341 patients. PJK occurred in 71 patients (21%) and PJF in 26 (7.5%). Both complications were revised at a mean of 25 months (standard deviation [SD] 1.7 mo for PJF and 2.2 for PJK) after the index surgery. Comparing the 3 periods, the incidence of PJK diminished from 43% (2008–2010) to 19% (2010–2015) and 21% (2015–2018) ($p < 0.001$). The same pattern was observed with PJF in those periods (19% v. 5% v. 9%, $p < 0.01$). No individual surgical factors significantly affected PJF/PJK rates ($p > 0.01$). **Conclusion:** Despite an initial decrease, PJK and PJF are still common complications. In our database, surgical strategies employed to limit proximal junctional problems, including ligamentoplasty, vertebroplasty, osteotomy and anterior support, had no effect on the incidence of proximal failure. The effect of more recently adopted strategies remains to be studied, including Roussouly and GAP concepts.

Presentation P65
Abstract 88
Describing the spine surgical learning curve during the first 2 years of practice. ***Devin Ferguson, Madison Stevens, Cynthia Dunning, William Oxner, Andrew Glennie.* From Dalhousie University, Halifax, N.S.**

Background: The first objective of this study was to characterize the surgical learning curve by a spine surgeon during the first 2 years of independent practice by comparing it with the trends of an experienced colleague over the same time period with a similar practice. The second objective was to stratify the learning curve by procedure to evaluate the effect of surgical experience on surgical complexity. **Methods:** Data from a retrospective cohort from 2014 to 2016 were analyzed at a quaternary academic institution. Procedures included were anterior cervical discectomy and fusion (ACDF), posterior cervical decompression and fusion, single- and 2-level posterior lumbar interbody fusion, lumbar discectomy and laminectomy. Deformity, anterior lumbar interbody fusion (ALIF), minimally invasive surgeries and osteotomy surgeries were excluded. Demographic data in addition to after-hours surgery and revision surgery (index > 2 yr prior) were collected. Operative time was the primary outcome measure; secondary outcome measures included cerebrospinal fluid (CSF) leak and early reoperation. Time periods were stratified into 6-month quarters with STATA software used for statistical analysis. **Results:** There were 626 patients meeting the inclusion criteria within the cohort. The new surgeon demonstrated a statistically significant decrease in operative time from Q1 to Q4 (158 min to 119 min, $p < 0.05$). The mean operative time, however, was statistically shorter for the senior surgeon at the 2-year mark (91 min, $p < 0.05$). The senior surgeon was more likely to perform revision surgeries than the novice surgeon (odds ratio [OR] 2.5, 95% confidence interval [CI] 1.7–3.6, $p < 0.001$). Posterior interbody fusion times remained longer for the new surgeon, while single- and 2-level laminectomy surgery was similar to that of the senior surgeon at the 2-year time point. There were no significant differences in rates of CSF leak among the surgeons (OR 1.2, 95% CI 0.6–2.5, $p > 0.05$). There was also an insignificant difference in rates of reoperation during the 2-year study period (OR 1.16, 95% CI 0.7–1.9, $p > 0.05$). **Conclusion:** A significant surgical learning curve exists starting practice and probably extends beyond the first 2 years. This information is useful for new graduates and programs so appropriate expectations and accommodations are ensured early in practice.

Presentation P66
Abstract 90
Factors contributing to prolonged length of stay in adults undergoing spine surgery: results from a quaternary spinal care centre. ***Mathew Hindi,[1] Charlotte Dandurand,[2] Scott Paquette,[3] Brian Kwon,[3] Tamir Ailon,[3] Marcel Dvorak,[3] Nicolas Dea,[3] Raphael Charest-Morin,[3] Charles Fisher,[3] John Street.[3]* From the [1]University of British Columbia Faculty of Medicine, Vancouver, B.C.; the [2]Division of Neurosurgery, University of British Columbia Faculty of Medicine, Vancouver, B.C.; and the [3]Department of Orthopedic Surgery, University of British Columbia, Vancouver, B.C.**

Background: The goal of this study is to identify patient, surgical and systemic factors associated with prolonged length of stay (LOS) for adults undergoing spine surgery at a quaternary spinal care centre. **Methods:** Data were collected prospectively on all consecutive admissions from January 2006 to October 2020. LOS values were expressed as mean, median and standard deviation. Factors analyzed included admission status (urgent v. elective), diagnostic category (degenerative, deformity, oncology, trauma), American Spinal Cord Injury Association Impairment Scale (AIS), operative versus conservative management, operative time, estimated blood loss and intra- and postoperative adverse events (AEs). Univariate and multivariate analyses determined factors significantly associated with prolonged LOS. **Results:** A total of 14 673 patients met the inclusion criteria and had complete data. Overall mean LOS was 15.49 (standard deviation [SD] 33.40) days. Factors significantly associated with a prolonged LOS were emergency admission (mean 19.80 v. 11.13 d), AIS A-C (mean 54.25 v. 10.51 d), diagnoses of trauma (mean 23.51 v. 10.22 d) and oncology (mean 18.36 v. 12.83 d), operative management (mean 15.31 v. 11.48 d), neurologic deficits in patients with trauma (mean 33.52 v. 11.34 d), prolonged operative time (mean 20.10 min) and postoperative AEs (22.76 v. 5.84 d) including surgical site infection, urinary tract infection and systemic infection (35.07 v. 19.43 d). A key influencer of LOS is the variability in the data. Despite no clear trend in LOS from 2006 to 2020, the variability has progressively declined from 2006 (SD 43.42 d) to 2018 (SD 20.55 d). The steady increase in mean patient age, proportion of oncology admissions, and LOS of patients with degenerative disease over this time has probably been counteracted by initiatives aimed at improving systems, clinical protocols and care pathways. **Conclusion:** A granular understanding of LOS trends over time allows for

appropriate staffing, funding and planning at an organizational level. Identifying modifiable factors that increase LOS provides opportunities for quality improvement intervention at a care provision level. Understanding patient and disease factors that affect LOS allows for a more informed preoperative discussion with the patient.

Presentation P67
Abstract 91
The impact of COVID-19 restrictions on idiopathic scoliosis referrals: beware of the anticipated tsunami. ***Jennifer A. Dermott,[1] Dorothy Kim,[1] David E. Lebel.[1,2]*** **From the [1]Hospital for Sick Children, Toronto, Ont.; and the [2]Department of Surgery, University of Toronto, Toronto, Ont.**

Background: COVID-19 restrictions have affected pediatric health care utilization by limiting access or because families have deprioritized health concerns and not sought medical consultation. Decreased access to and use of health care services during the pandemic may delay diagnosis and referral of scoliosis patients. The primary objective of this study was to determine how restrictions related to COVID-19 may have affected the demographic and clinical profile of idiopathic scoliosis (IS) patients at initial presentation, with a particular focus on late referrals. **Methods:** The volume of spine referrals received and new IS clinic visits were compared between Mar. 15 and Oct. 15, 2019, and the same period in 2020. A retrospective chart and radiographic review detailed the patient profile at initial presentation. Comparative analysis examined the referral source, curve magnitude, skeletal maturity and consequently, treatment options. Brace treatment was in accordance with Scoliosis Research Society guidelines. Late referrals were those considered likely surgical candidates (i.e., curve magnitude ≥ 50°, or > 40° and Risser 2 or less). **Results:** Compared with 2019, the referral volume decreased in 2020 by 76% (n = 1311 v. 317). The number of IS patients seen for initial consultation decreased by 55% (n = 229 v. 148), with an increased proportion referred by a pediatrician. The 2 groups were similar in age (13.7 [standard deviation (SD) 2.1] yr v. 13.3 [SD 2.3] yr, p = 0.08), Risser score distribution (p = 0.32) and curve magnitude (37.1° [SD 3.8°] v. 39.0° [SD 16.0°], p = 0.22). The percentage of patients appropriate for brace treatment was consistent (17% v. 19%, p = 0.73) and although late referrals increased from 25% to 31%, this did not reach statistical significance (p = 0.1). **Conclusion:** Our results indicate that during the first 7 months of the COVID-19 pandemic, the clinical profile of new IS patients resembled that of patients in the previous year. However, there was a marked reduction in referral volumes. Given the stability of IS incidence, there is concern that the trend toward late referral will be accentuated in the year to come. This would adversely affect the likelihood of successful brace treatment and may overwhelm surgical programs that are already challenged by lengthy wait lists.

Presentation P68
Abstract 92
Is vertebral body tethering truly minimally invasive? A comparison of early postoperative outcomes to posterior spinal instrumentation and fusion. ***Zachary DeVries,[1] James Jarvis,[2] Andrew Tice,[2] Kevin Smit.[2]*** **From [1]The Ottawa Hospital, Ottawa, Ont.; and the [2]Children's Hospital of Eastern Ontario, Ottawa, Ont.**

Background: Vertebral body tethering (VBT) is a novel surgical technique that utilizes the remaining growth potential of the patient to correct their spinal deformity. It is reported to be minimally invasive and thought to have a theoretically faster recovery compared with posterior spinal instrumentation and fusion (PSIF); however, this has yet to be critically examined. It is the goal of this study to compare the differences in the early postoperative period for adolescent idiopathic scoliosis (AIS) patients undergoing either VBT or PSIF. **Methods:** This is a retrospective single-centre study at a tertiary children's hospital. All VBT patients were included in the analysis. The average age and thoracic curve magnitude of the VBT cases were used to select appropriately matched PSIF cases. Many preoperative, operative and postoperative features were selected. Student t tests were used to compare VBT to PSIF. Significance was set at p less than 0.05. **Results:** Twenty-two VBT patients and 21 PSIF patients were included in the analysis. Tethering patients had shorter operating times (4.0 [standard deviation (SD) 0.72] h) compared with fusions (5.3 [SD 1.0] h, $p < 0.05$) and had less blood loss (350 [SD 172] mL v. 704 [SD 300] mL, $p < 0.05$). Twenty-three percent of VBT patients stood at the bedside on postoperative day 0 and 77% were walking by postoperative day 1 whereas no patients were standing on postoperative day 0 and only 5% were walking by postoperative day 1 for the PSIF cohort. Postoperative pain was significantly lower on postoperative day 2 in VBT patients compared with PSIF patients (visual analogue scale [VAS] 2.2 [SD 1.4] v. 3.4 [SD 1.7]). Opioid use was significantly lower on both postoperative day 2 and 3 in the VBT group (33.7 [SD 25.9] mg and 14.1 [SD 20.3] mg) compared with the PSIF group (58.3 [SD 30.7] mg and 42.7 [SD 24.9], $p < 0.05$). Admitted time was significantly lower in the VBT cohort (3.1 [SD 0.46]) compared with the PSIF cohort (3.5 [SD 0.44], $p < 0.05$). **Conclusion:** This study demonstrates that VBT can be considered minimally invasive as it was found that it has a shorter operative time with less blood loss and is associated with a quicker physical recovery requiring less opioids compared with PSIF.

Presentation P69
Abstract 93
A modified enhanced recovery after surgery (ERAS) protocol reduces length of stay and opioid consumption in adolescents after idiopathic scoliosis surgery. ***David Lebel,[1] Fiona Campbell,[1] Masayoshi Mashida,[1] Lisa Isaac,[1] Natasha Bath,[1] Daniel Stocki,[2] David Levin,[1] Martin Koyle,[1] Danielle Ruskin,[1] Jennifer Stinson.[1]*** **From the [1]Hospital for Sick Children, Toronto, Ont.; and the [2]Dana-Dwek Children's Hospital, Tel Aviv, Israel.**

Background: Surgeries for adolescent idiopathic scoliosis (AIS) are among the most prevalent elective surgeries in pediatric orthopedic units. The optimization of postoperative patient care may reduce pain and opioid use and therefore decrease postoperative length of stay (LOS). We introduced a new modified enhanced recovery after surgery protocol (mERAS) based on preoperative management of patients'

expectations, multimodal analgesia, early mobilization, early removal of urinary catheters and a goals-based discharge checklist. We hypothesized that patients treated with mERAS will have reduced LOS, lower postoperative opioid consumption and less substantial pain. **Methods:** A retrospective chart review was completed for a consecutive group of patients treated between August 2018 and October 2019. All patients with a diagnosis of AIS were evaluated. Altogether 100 patients underwent surgery: 31 patients from the mERAS group and 52 patients from the non-ERAS (N-ERAS) group. Seventeen patients did not match either of those groups and therefore their data were excluded from this analysis. **Results:** Patients were comparable in baseline characteristics with regard to age at surgery, weight, height and number of levels fused, but they differed in their initial coronal Cobb angle (67.7° [standard deviation (SD) 12°] for the mERAS group and 76.3° [SD 19°] for the N-ERAS group, $p < 0.05$). LOS was 3.8 (95% confidence interval [CI] 3.5–4.2) days in the mERAS group compared with 4.76 (95% CI 4.5–5.1) days in the N-ERAS group ($p < 0.005$). The total opioid consumption was reduced by 50% on the day of surgery and by 35% the day after for the mERAS patients. Their mean and maximal pain scores were significantly lower in the first 48 hours after surgery compared with the N–ERAS group. No correlation was found between LOS and the initial Cobb angle. **Conclusion:** Adoption of an mERAS-based protocol for patients undergoing posterior spinal fusion to treat AIS led to significant reduction in LOS, pain intensity scores and opioid consumption.

Presentation P70
Abstract 94
Surgical outcomes of patients who fail to reach minimal clinically important differences: comparison of minimally invasive versus open transforaminal lumbar interbody fusion. ***Oliver Ayling, Tamir Ailon, Nicolas Dea, Charles Fisher*****. From the University of British Columbia, Vancouver, B.C.**

Background: A substantial proportion of patients will not meet minimal clinically important differences (MCID) on patient-reported outcomes (PROs) after transforaminal lumbar interbody fusion (TLIF). Previous studies have not compared subsets of patients who fail to reach MCIDs after open (O-TLIF) or minimally invasive (MIS-TLIF) TLIF to identify clinical variables associated with poor outcome that will assist in patient selection. **Methods:** We conducted an ambispective review of patients undergoing O-TLIF or MIS-TLIF for lumbar degenerative conditions (spondylolisthesis, lumbar stenosis and disc disease) enrolled in the Canadian Spine Outcomes and Research Network prospective registry. The outcomes of patients not meeting MCID on the Owestry Disability Index (ODI) at 2 years postoperatively were analyzed on PROs. **Results:** A total of 41.4% (181 of 437) and 42.1% (53 of 126) of patients in the O-TLIF and MIS-TLIF groups, respectively, did not reach a MCID of 15 on the ODI at 2 years. Patients had similar demographic characteristics. There were no significant differences between any baseline or postoperative PROs or rates of reaching the MCID on the EQ-5D, PCS, MCS or NRS back scores. However, the proportion of patients meeting MCID on the NRS-leg at 2 years was significantly higher in the O-TLIF group (75.63% v. 56.52%, $p = 0.015$). Multivariable regression analysis of the entire patient cohort demonstrated that higher baseline back pain scores, insurance claims and increasing blood loss were independently associated with worse ODI scores at 2 years ($p < 0.0001$, $p < 0.001$, $p = 0.015$). For the MIS-TLIF cohort, higher baseline back pain scores were associated with worse ODI scores at 2 years ($p = 0.01$). In the O-TLIF cohort, higher baseline back pain scores, symptom duration greater than 6 months and increasing blood loss were associated with worse ODI scores at 2 years ($p < 0.0001$, $p = 0.036$, $p = 0.039$). **Conclusion:** Similar rates of patients fail to reach MCID at 2 years on the ODI after open or MIS TLIF (approximately 40%). These data provide novel insights into patient counselling as well as surgical selection when deciding which patients will derive the most benefit from MIS or open spinal operations.

Presentation P73
Abstract 97
Assessment of spinal fusion rates in multilevel surgeries using lateral interbody cages and rhBMP-2. ***Vishwajeet Singh, Nathan Evaniew, Alex Soroceanu, Fred Nicholls, W. Bradley Jacobs, Ken Thomas, Roger Cho, Peter Lewkonia, Ganesh Swamy*****. From the University of Calgary, Calgary, Alta.**

Background: Multilevel spinal fusion can improve quality of life in many degenerative spinal conditions, especially in adult spinal deformity surgery. Historically, adult spine surgeries have been complicated with high pseudoarthrosis rates. Initial studies have reported 10%–15% rates of nonunion and even higher rates with multiple-level constructs. Introduction of rhMBP-2 improved the success rates of interbody fusion with achievable fusion rates equivalent to the gold-standard iliac crest bone graft (ICBG). Lateral lumbar interbody fusion (LLIF) allowed multilevel less invasive access to the anterior spine. We hypothesize that fusion rates using the lateral approach are better than historically published available data for spinal fusion. The primary outcome of the study is to investigate radiographic fusion rates with the lateral interbody approach, using rhBMP-2, in multiple-level constructs for adult spinal deformities. **Methods:** The University of Calgary adult spine deformity database was searched to identify eligible patients who underwent 2 level or more than 2 level LLIF in lumbar spine (T12–L5) between 2010 and 2018. Generally, 3–4 mg of rhBMP-2 was used in each LLIF. Patients with only supplemental posterior instrumentation at interbody fusion levels were included in the study. Plain coronal and sagittal 36-inch standing radiographs were obtained preoperatively and during follow-up. Computed tomography (CT) scans were obtained in select patients with suspicion of nonunion or implant-related complications. **Results:** There were 206 eligible patients with complete follow-up records. Median operated levels per patient were 3 (interquartile range 3–4). Mean follow-up duration was 4.4 years (standard deviation 1.9). A total of 193 patients (93.6%) had radiologic evidence of successful arthrodesis. Thirteen patients (6.3%) had radiologic nonunion at 1 interbody fusion level, of whom only 1 (0.4%) underwent revision surgery for a clinically significant pseudoarthrosis. **Conclusion:** This series represents the largest such

series reported to date and has the lowest pseudarthrosis rate in multiple-level interbody fusion. rhBMP-2 in LLIF can substantially decrease pseudoarthrosis rates in multilevel fusion procedures and can be considered as a new gold-standard bone graft material in spinal fusions.

Presentation P76
Abstract 100
Telehealth for outpatient spinal consultation: patient perspectives from the initial COVID-19 experience. ***Michael Craig,[1] Oliver Lasry,[2] Tamir Ailon.[1]*** **From the [1]University of British Columbia, Vancouver, B.C.; and [2]McGill University, Montreal, Que.**

Background: We aimed to identify patient-specific characteristics associated with a favourable telehealth experience for patients undergoing outpatient consultation. **Methods:** We enrolled consecutive patients undergoing telehealth spine consultation in the province of British Columbia during the initial months of the COVID-19 pandemic. We used an online, patient-reported survey that collected demographic and disease-specific information, as well as validated patient-reported outcome measures including visual analogue (VAS) pain scale, Oswestry Disability Index (ODI) and Neck Disability Index (NDI). Survey items also assessed the technical details of the telehealth consultation and the patients' perspectives of that experience. We assessed for any association between patient satisfaction and patient characteristics and disease severity via univariate and multivariate analysis. We also summarized patients' qualitative responses regarding their impressions of their telehealth experience. **Results:** A total of 171 unique responses were collected from June to November 2020. When stratified into satisfied (n = 145) and unsatisfied (n = 26), the groups were comparable in terms of age, sex and proportion of patients living outside of the referral centre. Scores for VAS for back pain (5.86 [standard deviation (SD) 2.96] v. 6.33 [SD 2.05], $p > 0.05$) and leg pain (5.63 [SD 3.23] v. 5.81 [SD 2.87], $p > 0.05$) were not statistically different between groups, as was also the case for VAS neck and arm pain scores. ODI was not statistically different between groups (37.8 [SD 18.8] v. 39.6 [SD 15.5], $p > 0.05$).

Presentation P77
Abstract 103
Transformation of radial stress to axial stress through morcellized bone graft for interbody applications. ***Timothy Lasswell,[1] Nima Zamani,[2] Raja Rampersaud,[3] Parham Rasoulinejad.[4]*** **From [1]McMaster University, Hamilton, Ont.; the [2]University of Waterloo, Waterloo, Ont.; the [3]University of Toronto, Toronto, Ont.; and [4]Western University, London, Ont.**

Background: We conducted a feasibility study for a device that applies radial stress to a central bone graft, causing the bone graft to generate axial stress on vertebral end plates. The goal of this study was to generate data that will guide design direction of an interbody device that actively loads graft material with the potential benefit of reducing subsidence and maintaining lordosis. **Methods:** Eight Nitinol specimens with shape memory properties were used to generate radial stress on morcellized bone graft. The Nitinol was axially strained with a tensile tester in straight strip configuration. During straining, the temperature of the strips was maintained at –45°C and tensile loading was applied to generate a strain of 6%. The strained Nitinol strips were formed into rings with a diameter of 25 mm, height of 5 mm and wall thickness of 600 µm. Morcellized bone graft was packed into each ring and the rings were sandwiched between 2 plates attached to a load cell. A heat gun was used to activate the shape memory effect, causing the Nitinol to apply a radial stress to the bone graft, in turn causing the bone graft to apply a resultant axial stress on the load cell. Both radial and axial loads were reported at 37°C to represent body temperature. **Results:** Nitinol training established an axial plateau force of 450 N. Upon cooling to 37°C, the load cell recorded an average axial force of up to 123 N exerted by the bone graft. **Conclusion:** Initial findings suggest that there is transformation of radial stress to axial stress through morcellized bone graft. These findings are relevant to interbody cages that may utilize this principle to maintain lordosis while loading bone, creating an environment that stimulates fusion based on the principle of Wolff's law. This study will be used to guide the design of a novel interbody cage.

