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2014
Combined Spine Conference of the

Canadian Spine Society
New Zealand Orthopaedic Spine Society
Spine Society of Australia

Fairmont Château Lake Louise
Lake Louise, Alberta

Tuesday, Feb. 25 to Saturday, Mar. 1, 2014

This event is an accredited group learning activity as defined by the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada. The Annual Scientific Conference of the Canadian Spine Society provides a yearly review of spine care in Canada. This year the first combined conference widens its perspective to encompass participation by both the Spine Society of Australia and the New Zealand Orthopaedic Spine Society. There is also an increased contribution from paediatric spine. In addition to a review of surgical advances, the agenda covers a range of non-operative innovations and epidemiological studies. Presentations by members of the three societies will highlight the similarities, differences and common problems in three separate health care systems. Of particular interest are the management of neuromuscular spinal deformity and motion preserving surgery for degenerative back pain. A special focus is the development of national spine registries. Parallel efforts in all three countries will be compared and the conference will consider the possibility of international cooperation.

Abstracts

Podium presentations

Wednesday, February 26, 2014

1.1.01

The use of suspension radiographs to predict LIV tilt. ***H. van West,[*] J.-M. Mac-Thiong,[*] H. Labelle,[*] D. Moulin,[†] I. Turgeon,[*] M. Roy-Beaudry,[*] N. Bourassa,[‡] Y. Petit,[†] S. Parent.[*]*** **From the *CHU Sainte-Justine, †École Technologie Superieure, and ‡École Polytechnique, Montréal, Que.**

Background: In adolescent idiopathic scoliosis (AIS) surgery the goal is to obtain a well-balanced correction of the spine while preserving as much mobility as possible. Due to the powerful effect of pedicle screw constructs in correcting scoliosis the lowest instrumented vertebra (LIV) tends to be chosen higher, leaving more lumbar mobility. Suspension radiographs have been proposed to assess curve flexibility, but their ability to predict the LIV has not been studied. Objectives of this study are to evaluate the correlation between preoperative, suspension and postoperative LIV tilt and to try to determine a threshold value for LIV tilt in suspension to help the surgeon identify an appropriate LIV. **Methods:** Thirty patients with AIS surgically treated using pedicle screw constructs were evaluated by preoperative standing, suspension, as well as postoperative standing radiographs. Vertebra tilting, disc wedging and vertebra translation were compared for the LIV at each time point (preoperative, suspension, postoperative). **Results:** Mean tilt of the LIV was 22.7° (± 6.1) preoperatively, 12.8° (± 5.5) in suspension and 6.3° (± 4.3) postoperatively. The assessment of LIV tilt from suspension and postoperative radiographs demonstrated a strong correlation (r = 0.5 with $p = 0.005$). All but one of the 11 patients with a postoperative LIV tilt under 5° had a suspension LIV tilt under 15° whereas 10 out of 19 patients with a postoperative LIV tilt over 5° had an LIV tilt in suspension over 15°. The LIV disc wedging and translation didn't show any correlation between suspension and the postoperative radiographs. **Conclusion:** There is a strong correlation between suspension and postoperative radiographs looking at LIV tilt, whereas the LIV tilt in the suspension radiographs seems to correctly predict the postoperative LIV tilt by a factor of 50%. In our cohort, when LIV tilt in suspension was < 15°, the postoperative LIV tilt was < 5°. This study suggests that the LIV selection could be improved with the addition of a suspension radiograph.

1.1.02

Surgical correction of adolescent idiopathic scoliosis without fusion: an animal model. ***B. Hodgson.*** **Otago Medical School, University of Otago, Dunedin, New Zealand**

Background: Surgical correction of adolescent idiopathic scoliosis (AIS) involves not only deformity correction but also fusion. Fusion has inherent long-term consequences of loss of movement, growth disturbance and back pain associated with adjacent level disc disease. A surgical device to correct deformity, allow growth and preserve motion has been developed and perfected in an animal (sheep) model. The scoliosis deformity has been corrected and maintained till skeletal maturity. **Methods:** A method of producing a scoliotic deformity model in 6-week lambs was created using a unilateral tether. Stage 1: The lambs had the tether released 3 months and were watched for a further 3 months to assess spontaneous correction. Stage 2: A surgical device to correct the lordosing-scoliotic deformity was implanted at 6 months. The lambs were followed to skeletal maturity (2 yr). **Results:** Four sets of 5 lambs underwent stage 1 surgery from 2008 to 2011 (20). Fifteen lambs underwent stage 2 surgery from 2008 to 2011. (4:3:4:4). All lambs retained their Stage 2 implants (correction device) until 2 years or skeletal maturity. Seventy-five percent correction of the created scoliotic deformity was obtained. Spontaneous fusion was found to have occurred in 25% of animals in 2008 and 2009, prompting a modification in surgical technique during implantation. **Conclusion:** The surgical correction device proved to be reliable with satisfactory correction of the created spinal deformity in the sheep model. Growth was shown to occur and motion was preserved in those animals not undergoing spontaneous fusion. The ethical approval application is now underway for an experimental trial in the human patient.

1.1.03

Are full torso surface topography postural measurements more sensitive to change than back only parameters in adolescents with idiopathic scoliosis and a main thoracic curve? ***E. Parent,[*] S. Chabot,[*] L. Westover,[*] D. Hill,[*†] M. Moreau,[*†] D. Hedden,[*†] E. Lou,[*†] S. Adeeb.[*]*** **From the *University of Alberta, Edmonton, Alta., and †Alberta Health Services, Edmonton, Alta.**

Background: Changes in external body shape due to scoliosis can be quantified by surface topography (ST). Full-torso ST and back-only scans can be acquired but the sensitivity-to-change of full-torso parameters is unknown. The study goal was to compare the sensitivity-to-change of the Cobb angle, full-torso, and back-only parameters. **Methods:** Prospectively, 42 adolescents (32 female) with idiopathic scoliosis with a main thoracic curve, treated with bracing (22) or observation (20), completed 2 full-torso ST scans one year apart. Subjects were scanned standing in a positioning frame using 4 laser scanners. One evaluator marked 11 landmarks then scanned. Eighteen full-torso and 16 back-only parameters were extracted in Matlab by an evaluator digitizing landmarks on anonymized scans presented randomly. The absolute value of the difference between baseline and follow-up quantified changes because of surface improvement or deterioration can occur with changing curvatures. Standardized response mean (SRM) coefficients quantified the sensitivity-to-change. The SRMs are interpreted as: 0.2–0.5 = small, 0.5–0.8 = moderate, over 0.8 = large. **Results:** Baseline age was 13.9 ± 1.7 years with a baseline Cobb angle of 24 ± 12 compared with 25 ± 16º at discharge. The Cobb angle SRM was large (0.92). All but 1 full-torso (frontal asymmetry ratio SRM = 0.26) and all except 2 back-only measurements had large sensitivity-to-change. The kyphotic angle and deformity-in-axial-plane-index had SRMs of 0.73 and 0.79, respectively. Fourteen full-torso and 14 back-only parameters had sensitivity-to-change at least as good as the Cobb angle but none were significantly better. The measurements most

sensitive-to-change in axial, frontal and sagittal deformity were decompensation, trunk twist, and lordotic angle, respectively. **Conclusion:** For main thoracic curves, several full-torso and back-only parameters have sensitivity-to-changes in surface deformity in all 3 planes at least as large as the Cobb angle. Full-torso scans may not be necessary to capture changes in surface deformity but may still be justified if correlations with patient's perceptions of appearance are stronger with full-torso than back-only parameters.

1.2.04

Restoration of thoracic kyphosis in adolescent idiopathic kyphosis: comparative radiographic analysis of round versus rail rods. ***S. Samuel,*†** ***M. Smith,*‡** ***C. Bridge,*** ***B. Hsu,*** ***R. Gray.*†** **From the *Childrens Hospital at Westmead, Westmead, NSW, Australia, †Royal North Shore Hospital, and the ‡Kolling Institute of Medical Research, RNSH, St Leonards, NSW, Australia**

Background: To determine if using a novel "beam-like" low-profile rail rod design aids in better restoration of thoracic kyphosis (TK) compared with traditional round rods in posterior surgical correction of adolescent idiopathic kyphosis (AIS) using a pedicle screw based construct. **Methods:** A consecutive series of 19 patients who underwent posterior correction of AIS with rail rods (5.5 mm cobalt-chrome) by 2 surgeons was identified. Patients with Lenke type 5 AIS were excluded. This series was randomly matched for preoperative TK to a cohort of 19 patients who underwent posterior correction of AIS using round rods (5.5 mm cobalt-chrome and/or titanium alloy) in the period immediately before use of rail rods by the same 2 surgeons. Data collected included age, sex, weight, Lenke classification, number of levels fused, pre- and postop TK, Coronal Cobb (CC) and sagittal balance (SB). **Results:** There was no significant difference in age, sex, body weight, number of levels fused, Lenke type preop TK, preop SB or preop CC between the 2 groups. There were no significant postop changes in SB or CC. Postop TK and change in TK were both significantly greater in the rail compared with the round rod group (26.7° v. 18.2°, $p = 0.006$ and –6.4° v. 3.4°, $p = 0.002$, respectively). Seventy-nine percent of the patients in the Rail rod group had postop TK in the 20°–40° range in contrast to only 37% for the round rod group ($p = 0.002$). On linear regression analysis, the difference in change of TK between the 2 groups was 10.7° (4.4, 17.0; $p = 0.002$) when corrected for sex and number of levels fused. Age and body weight had no effect as covariates in this regression model. **Conclusion:** Compared with round rods, the use of rail rods for posterior surgical correction of AIS leads to a significantly greater postop TK. The use of rail rods leads to better restoration of TK.

1.2.05

Scoliosis surgery in spastic quadriplegic cerebral palsy: Is fusion to the pelvis always necessary? A 4–18-year follow-up study. ***B. Hodgson.*** **From Otago Medical School, Dunedin, New Zealand**

Background: To demonstrate that fusion to the lumbar spine in selected patients (pelvic obliquity [PO] < 20°) provides satisfactory and comparable long-term results with patients fused to the sacrum. **Methods:** Thirty-six consecutive patients from 1992 to 2006 with spastic quadriplegia were reviewed. Eight patients were excluded leaving 28. All patients were assessed and surgery performed by a single surgeon. If pelvic obliquity was less than 20º fusion was performed to the lumbar spine preserving mobility at the lumbo-sacral junction. If PO was greater than 20º fusion was taken down to the sacrum. Patients were assessed clinically; medical records and X-rays were reviewed from the relevant South Island hospitals. Data collected included: 1) age at operation, 2) levels of fusion, 3) preop Cobb angle and PO, 4) postop Cobb angle and PO, 5) blood loss, 6) operative time, 7) perioperative death and 8) need for revision. **Results:** Nine patients under went fusion to the sacrum. Nineteen were fused to the lumbar spine. The mean age at surgery was 13.5 years. Mean follow up was 7.35 years (4–18). Intraoperative blood loss was increased when fusing to the sacrum. In both groups the Cobb angle improved. PO was maintained in all cases fused to the sacrum. In patients fused to the lumbar spine PO was maintained less than 20º in all but 1 patient. Two revision procedures were carried out in the sacral group, 1 in the lumbar spine group. Two infections occurred in the lumbar fusion group requiring removal of metal. **Conclusion:** Fusion to the sacrum does not appear necessary in selected patients with PO under 20º preoperatively. Cobb angles and PO are well maintained at average 7.35 year follow-up. Both groups have similar outcomes if revision is used as an end point. Theoretically sparing the lumbo-sacral junction should improve mobility for transfers and facilitate care. Operative time and blood loss are reduced when fusing to the lumbar spine. However counterintuitively, there were 2 more infections in the lumbar spine group.

1.2.06

Identification and validation of pain-related biomarkers surrounding spinal surgery in adolescents. ***C. Ferland,*†** ***PORSCHE Study Group,*§** ***N. Saran,*‡** ***J.-M. Mac-Thiong,*‡** ***L. Stone,*†‡** ***J. Ouellet.*‡** **From *Shriners Hospital for Children, Montréal, Que., †Alan Edwards Centre for Research on Pain, McGill University, Montréal, Que., ‡McGill Scoliosis & Spinal Research Group, Montréal, Que., §IWK Health Centre, Dalhousie University, Halifax, NS, and ¶Hôpital Sainte-Justine, CHU, Montréal, Que.**

Background: The objective of this longitudinal observational investigation is to identify associations between the expression of pain biomarkers in physiologic fluids and the experience of pain in a pediatric population in the perioperative period. **Methods:** Patients undergoing spinal surgery for adolescent idiopathic scoliosis were invited to participate. Study participants ($n = 20$) completed validated pain questionnaires on the preoperative consult visit (~1 wk preop), 48 hours postsurgery, and on their first postoperative visit (~4 wk postop). During the preoperative consult, saliva and blood samples were collected. Saliva and blood samples were also collected on the day of surgery, with the addition of a cerebrospinal fluid (CSF) sample. Other sets of saliva and blood samples were collected 48 hours and 4 weeks post-surgery. Biomarkers were analyzed in triplicate using commercially available ELISA kits according to the manufacturers' instructions. **Results:** The severity of the scoliosis was not related with the postoperative pain reported by patients at any time point or with any other psychosocial variables. Patients' pain perception was significantly increased immediately after surgery

but returned to preoperative values within 4 weeks. Interestingly, certain biomarkers concentrations also demonstrated variation over time such as significant increases in cortisol on the day of surgery and of proinflammatory mediators 48 hours postsurgery. Saliva and CSF taken during surgery were highly correlated for cortisol levels, suggesting that saliva may be a useful proxy for biomarkers reflecting CNS regulation. **Conclusion:** These preliminary results aim to provide a deeper understanding of a patient's pain perception, and to serve as objective quantitative predictors of children's postoperative pain burden. Preliminary results validate our experimental model as a useful approach for the identification of pain-specific biomarkers. The data obtained from this pilot study will be used to provide rationale for a larger, more comprehensive and powerful study.

1.3.07

Cervical sagittal deformity develops after PJK in adult throacolumbar deformity correction: radiographic analysis using a novel global sagittal angular parameter, the CTPA. ***A. Soroceanu,* T. Protopsaltis,* J. Terran,* N. Bronsard,*† J. Smith,‡ E. Klineberg,§ G. Mundis,¶ R. Hostin,** R. Hart,†† C. Shaffrey,‡ S. Bess,‡‡ C. Ames,§§ F. Schwab,* V. Lafage.*** **From *New York University, Department of Orthopaedic Surgery, New York, NY, †Hopital Saint-Roch, Nice, France, ‡University of Virginia School of Medicine, Department of Neurosurgery, Charlottesville, Va., §University of California Davis, Sacramento, Calif., ¶San Diego Center for Spinal Disorders, La Jolla, Calif., **Baylor Scoliosis Center, Plano, Tex., ††University of Oregon Health Sciences Center, Portland, Oreg., ‡‡Rocky Mountain Hospital for Children, Presbyterian/St Luke's Medical Center, Denver, Colo., and the §§University of California San Francisco, San Francisco, Calif.**

Background: Proximal junctional kyphosis (PJK) is a prevalent problem following sagittal correction in adult spinal deformity (ASD). Reciprocal changes in cervical lordosis have been demonstrated after pedicle subtraction osteotomy (PSO) but changes in cervical alignment after PJK have not been investigated. This study introduces 2 novel global sagittal angular parameters, the cervical-thoracic pelvic angle (CTPA) and the T1 pelvic angle (TPA), and utilizes them to look at the changes in cervical alignment in adults with PJK after thoracolumbar deformity correction. **Methods:** Multicentre, retrospective, analysis of consecutive ASD patients undergoing PSO with fusion to the pelvis. Subgroup analysis was performed for patients with fusion into the upper thoracic spine (UT group) versus lower thoracic spine (LT group), using a threshold of UIV at T6. **Results:** A total of 166 ASD patients were identified. Proximal junctional kyphosis developed in 62 patients (37.3%). Cervical-thoracic pelvic angle correlated strongly with C2-C7 plumbline (CPL) (r = 0.916, $p < 0.001$), with a CTPA of 3.6 corresponding to CPL of 4.0 cm. Preoperative thoracolumbar deformity (SVA, TPA), cervical alignment (CPL, CTPA), age, sex and body mass index were not predictors of PJK. Postoperative throacolumbar alignment and magnitude of correction did not predict the incidence of PJK. Subgroup analysis showed that for the UT group ($n = 86$), patients with PJK had larger CTPA (4.7 v. 3.6, $p = 0.008$), CPL (4.83 v. 3.92 cm, $p = 0.03$), CL (20.1 v. 7.32, $p = 0.001$) and T1 slope (36.0 v. 26.9, $p = 0.003$) when compared with non-PJK patients. This difference was not observed in the LT group. **Conclusion:** Overall, CTPA correlated strongly with CPL as a global analog of cervical sagittal balance. The incidence of PJK in ASD patients undergoing PSO was 37.3%. The PJK patients with long fusions to the upper thoracic spine (UT) developed cervical sagittal deformities with an increase in their CPL and CTPA. These patients had to compensate for increases in their T1 slope by creating more cervical lordosis.

1.3.08

Impact of obesity on complications and patient-reported outcomes in adult spinal deformity surgery. ***A. Soroceanu,*¶ F. Schwab,* V. Lafage,* T. Protopsaltis,* C. Ames,† S. Bess,§ J. Smith,‡ T. Errico.*** **From *New York University Hospital for Joint Diseases, New York, NY, †University of California, San Francisco, Calif., ‡University of Virginia, Charlottesville, Va., §Rocky Mountain Hospital for Children, Denver, Colo., and ¶Dalhousie University, Halifax, NS**

Background: Adult spinal deformity (ASD) surgery is known for its high complication rate. This study looks at the impact of obesity on complication rates and patient-reported outcomes in operative ASD patients. **Methods:** Retrospective review of a multicentre prospective database of operative ASD patients. Obesity was defined by a body mass index of 30 or greater. Outcomes included complications (total, minor, major, implant related, radiographic, infection, revision, and neurologic injury), estimated blood loss (EBL), operative time, length of stay (LOS) and patient reported questionnaires (visual analogue scale [VAS] back/leg pain, Oswestry Disability Index [ODI], SF-36, Lumbar Stiffness Disability Index [LSDI], Scoliosis Research Society [SRS]). The impact of obesity was studied using multivariate Poisson, linear, or logistic regression modelling. Models accounted for confounders, as determined by univariate analysis and expert opinion. **Results:** A total of 310 patients were identified (219 nonobese, 91 obese), with 1-year follow-up on 255 patients. Regression models showed that obesity increased the risk of overall complications (incidence rate ratio [IRR] 1.4, $p = 0.032$), major complications (IRR 2.14, $p < 0.005$), and infection (odds ratio [OR] 3.17, $p = 0.029$). Obesity showed a trend toward increasing implant-related complications (OR 1.92, $p = 0.1$). Obesity did not increase the number of minor and radiographic complications, neurologic injury and revision. Obesity increased OR time (58 min, $p = 0.004$), but did not influence LOS or EBL. Obesity was associated with worse function on preoperative patient-reported outcome measures (VAS back 7.7 v. 6.7, $p = 0.001$; VAS leg 5.1 v. 3.8, $p = 0.003$; ODI 49.7 v. 37.9, $p < 0.0005$; SF36p 28.4 v. 34.99, $p = 0.0005$; LSDI 36.95 v. 26.72, $p < 0.0005$). At 1-year postsurgery both groups achieved similar improvements on all patient-reported outcomes ($p > 0.05$). **Conclusion:** This study shows that obese patients are a higher risk group than the general ASD population, with twice the risk of major complications and 3 times the risk of infection. However, despite increased complications, obese patients do benefit from ASD surgery and experience improvements similar to that of nonobese patients on patient-reported outcomes 1-year postsurgery.

1.3.09

The T1 pelvic angle, a novel radiographic measure of sagittal deformity, accounts for both pelvic retroversion

and truncal inclination and correlates strongly with HRQOL. ***T. Protopsaltis,[*] F. Schwab,[*] A. Soroceanu,[*¶¶] N. Bronsard,[*] J.S. Smith,[†] E. Klineberg,[‡] G. Mundis,[§] R. Hostin,[¶] R. Hart,[**] D. Burton,[††] C. Ames,[‡‡] C. Shaffrey,[†] S. Bess,[§§] T. Errico,[*] V. Lafage.[*]*** **From *New York University School of Medicine, Department of Orthopedic Surgery, New York, NY, †University of Virginia School of Medicine, Department of Neurosurgery, Charlottesville, Va., ‡University of California Davis, Department of Orthopedic Surgery, Sacramento, Calif., §San Diego Center for Spinal Disorders, La Jolla, Calif., ¶Baylor Scoliosis Center, Plano, Tex., **University of Oregon Health Sciences Center, Department of Orthopedic Surgery, Portland, Oreg., ††University of Kansas School of Medicine, Department of Orthopedic Surgery, Kansas City, Kans., ‡‡University of California San Francisco, Department of Neurosurgery, San Francisco, Calif., §§Rocky Mountain Hospital for Children, Presbyterian/St Luke's Medical Center, Denver, Colo., and ¶¶Dalhousie University, Halifax, NS**

Background: Established measures of sagittal alignment, such as sagittal vertical axis (SVA) and pelvic tilt (PT), can be modified by postural compensation, including pelvic retroversion and knee flexion. We introduce the T1 pelvic angle (TPA), a novel radiographic measure of sagittal alignment, which is less dependent on postural factors. The TPA is the angle of a line from the centre of T1 to the femoral heads (FH) and a line from the FH to the centre of the S1 end plate. The purpose of this study is to investigate the relationship of TPA and established measures of sagittal alignment and to correlate them with health-related quality of life (HRQOL) measures. **Methods:** A multicentre, prospective, analysis of consecutive adult spine deformity (ASD) patients was completed. Inclusion criteria included ASD, age over 18 years, and any of the following: scoliosis Cobb angle greater than 20º, SVA greater than 5 cm, thoracic kyphosis greater than 60º, and PT greater than 25°. Clinical measures of disability included Oswestry Disability Index (ODI), Scoliosis Research Society (SRS) and SF-36. **Results:** A total of 559 consecutive ASD patients (mean age 52.5 yr) were enrolled. T1 pelvic angle correlated with SVA (r = 0.837), PI-LL (r = 0.889) and PT (r = 0.933). Categorizing the patients by increasing TPA (< 10°; 10–20°; 20–30°; > 30°) revealed a progressive worsening in HRQOL (all $p < 0.001$). TPA and SVA correlated strongly with ODI (0.435, 0.457), SF36 PCS (–0.440, –0.465) and SRS (–0.304, –0.360). Using a linear regression analysis, the threshold for TPA of 20 was found to correspond to a severe disability (ODI > 40) and the meaningful change corresponding to 1 MCID was found to be 4.1. **Conclusion:** The TPA correlates well with HRQOL in patients with ASD. Since the TPA is an angular and not a linear measure, it does not require calibration of the radiograph. Thus TPA measures sagittal deformity independent of many postural compensatory mechanisms and it can be used as an intraoperative tool to measure global correction with a target TPA of less than 14°.

1.4.10

Determining cervical sagittal deformity when it is concurrent with thoracolumbar deformity. ***T. Protopsaltis,[*] J. Terran,[*] A. Soroceanu,[***] N. Bronsard,[*†] J. Smith,[‡] E. Klineberg,[§] G. Mundis,[¶] H. Jo Kim,[**] R. Hostin,[††] R. Hart,[‡‡] C. Shaffrey,[‡] S. Bess,[§§] C. Ames,[¶¶] F. Schwab,[*] V. Lafage.[*]*** **From *New York University School of Medicine, Department of Orthopedic Surgery, New York, NY, †Hopital Saint-Roch, Nice, France, ‡University of Virginia School of Medicine, Department of Neurosurgery, Charlottesville, Va., §University of California Davis, Department of Orthopedic Surgery, Sacramento, Calif., ¶San Diego Center for Spinal Disorders, La Jolla, Calif., **Hospital for Special Surgery, Department of Orthopedic Surgery, New York, NY, ††Baylor Scoliosis Center, Plano, Tex., ‡‡University of Oregon Health Sciences Center, Department of Orthopedic Surgery, Portland, Oreg., §§Rocky Mountain Hospital for Children, Presbyterian/St Luke's Medical Center, Denver, Colo., ¶¶University of California San Francisco, Department of Neurosurgery, San Francisco, Calif., and ***Dalhousie University, Halifax, NS**

Background: Cervical sagittal deformity (CSD), as measured using cervical kyphosis (CK) and C2-C7 plumb line (CPL), is associated with poor health-related quality of life. However, reciprocal changes in cervical alignment have been demonstrated in patients undergoing thoracolumbar deformity (TLD) correction. Cervical sagittal deformity is difficult to determine in these patients. This study utilizes T1 slope minus cervical lordosis (TS-CL) to identify patients with concurrent cervical and thoracolumbar deformity following thoracolumbar 3 column osteotomy (3CO) and identifies risk factors for progression of CSD. **Methods:** Multicentre retrospective analysis of consecutive TLD patients undergoing pedicle subtraction osteotomy (PSO). Pre- and postoperative parameters of cervical alignment included: CK, CPL, cervical-thoracic pelvic angle (CTPA), and TS-CL. A TS-CL threshold of 17 (consisting of a CPL of 4 cm) was used to differentiate patients with CSD from patients with reciprocal spinal alignment (RSA). **Results:** A total of 166 patients were identified. Cervical-thoracic pelvic angle correlated with CPL (preop r = 0.85, postop r = 0.91). T1 slope minus cervical lordosis correlated with CTPA (preop r = 0.53, postop r = 0.47) and CPL (preop r = 0.57; postop r = 0.48). CSD had greater preoperative CPL (4.5 v. 3.4, $p < 0.001$) and CTPA (3.4 v. 2.3, $p < 0.001$) and greater 1-year CPL (4.7 v. 3.2, $p < 0.001$) and CTPA (4.3 v. 2.9, $p < 0.001$). The RSA patients had a decrease in TS-CL (10.2–8.0) with SVA correction whereas CSD patients had an increase in TS-CL (22.3–26.8) with all $p < 0.001$. Reciprocal change was demonstrated in RSA as CL decreased with SVA correction (r = 0.39) but there was no such correlation in CSD. Linear regression analysis identified UIV above T4 and preop TS-CL mismatch as risk factors for postoperative CSD. **Conclusion:** Patients with RSA had an improvement in cervical alignment after 3CO, while those with CSD experienced progression of the cervical deformity over time. Risk factors for developing cervical sagittal deformity following PSO for TLD included UIV above T4 which may result from disruption of the cervical paraspinal muscle attachments in the upper thoracic spine.

1.4.11

The influence of sagittal balance and pelvic parameters on the outcome of surgically treated patients with degenerative spondylolisthesis. ***I. Radovanovic, J. Urquhart, V. Gananapathy, F. Siddiqi, K. Gurr, C. Bailey.*** **Western University, London, Ont.**

Background: To determine the influence of sagittal balance on patient-rated outcome measures for patients treated surgically for lumbar degenerative spondylolisthesis (LDS) and spinal stenosis. **Methods:** A retrospective review was undertaken using a prospectively maintained database of consecutive surgical patients with LDS (2006–2011). Radiographic measurements included sagittal vertical axis (SVA), pelvic incidence, pelvic tilt, sacral slope, thoracic kyphosis, and lumbar lordosis. Two reviewers measured radiographic parameters independently using standardized methodology (spinal deformity study group 2008). Functional outcome measures included: Oswestry Disability Index (ODI), SF-36, Zurich Claudication score and numerical rating scale (NRS) 0–10 for back pain. Interrater variability of radiographic parameters was assessed using the Intraclass Correlation Coefficient (ICC). Baseline characteristics, radiographic and functional outcomes were compared between sagittal vertical axia (SVA) < 50 mm and SVA ≥ 51 mm using a Student *t* test for continuous parametric variables or a χ^2 test for categorical variables. Correlations between radiographic variables and outcomes were made using Pearson R. **Results:** A total of 86 of 140 patients were included in the final cohort. The majority of excluded patients did not have follow-up ≥ 12 months or adequate radiographic images. There was no difference in baseline demographics or functional outcomes between patients excluded and included. The ICC was 0.994 for all radiographic parameters. There was no significant difference in baseline demographics between patients with an SVA < 50 mm versus an SVA ≥ 51 mm. However, the SVA ≥ 51 mm cohort had a significantly lower lumbar lordosis and pelvic incidence minus lumbar lordosis. The SVA ≥ 51 group had a significantly lower SF-36 physical component summary score, significantly higher ODI, back pain, and Zurich score. The SVA correlated inversely with SF-36 and ODI. Thoracic kyphosis negatively correlated with back pain. **Conclusion:** Our study is the first to demonstrate that sagittal balance influences patient outcome following surgery for LDS and should be carefully considered during preoperative and intraoperative planning.

1.4.12

Predictors of degenerative spondylolisthesis and loading translation in surgical lumbar spinal stenosis patients.
R. Amritanand,*‡ B. Ravi,* K. David,† R. Rampersaud.*‡
From the *Division of Orthopaedic Surgery and Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ont., †Toronto Western Hospital, University Health Network, Toronto, Ont., and the ‡Spinal Program, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, Toronto, Ont.

Background: The objective of our study is to identify independent patient demographics and radiographic parameters that may predict spondylolisthesis and loading translation in surgical lumbar spinal stenosis (LSS) patients. **Methods:** The radiographs and magnetic resonance images (MRIs) of 153 consecutive surgical LSS patients from a single surgeon were reviewed. Pelvic incidence (PI), mean facet angle (FA), change in disc height and loading translation (LT, defined as any increase in anterior translation from supine MRI to standing X-ray) were measured from preoperative MRIs and standing radiographs. Multivariable logistic regression was used to determine predictors of spondylolisthesis; *t* test and χ^2 analyses were used to assess the associations of radiographic variables with LT. **Results:** The odds of spondylolisthesis were significantly higher in females (adjusted odds ratio [OR] [95% CI] 2.56 [1.19–5.63], $p = 0.017$), and in patients with higher PI: each additional degree of PI was associated with odds of spondylolisthesis 1.05 (95% CI 1.02–1.08) times as great. The odds were significantly lower with increasing (i.e., more horizontal) mean FA (OR 0.95 [0.92–0.99], $p = 0.006$). Age, body mass index and disc height were not significantly associated with odds of spondylolisthesis. Among patients with spondylolisthesis, LT occurred more often with a higher PI: 59° ± 15° versus 53° ± 13° ($p = 0.02$); a higher PI was also marginally significant in those with over 3 mm of LT ($p = 0.06$); facet angle and disc height were not significantly associated with LT. **Conclusion:** This study indicates that women with higher PI and lower FA have a greater risk of spondylolisthesis, and that a higher pelvic incidence may predict instability in patients with spondylolisthesis. Based on these findings we hypothesize that PI alone or in combination with other anatomic factors, may play an important role in surgical decision making (e.g., to fuse or not to fuse) for degenerative spondylolisthesis and warrants further investigation.

Thursday, February 27, 2014

2.1.13

Mechanical allodynia following disc herniation requires intraneural macrophage infiltration and can be blocked by systemic selenium delivery or attenuation of BDNF activity.
M. Shamji,*† Y.S. Tu,* M. Salter.* **From the *University of Toronto, Toronto, Ont., and the †Toronto Western Hospital, Toronto, Ont.**

Background: Disc herniation–induced radiculopathy arises from both mechanical compression and biochemical inflammation of apposed neural elements. This study demonstrated the need for intraneural macrophage migration after placement of heterotopic disc tissue to generate the painful neuropathy phenotype. **Methods:** C57BL/6 mice underwent a surgical procedure with mid-thigh exposure of the sciatic nerve. Control animals underwent exposure only ($n = 12$) and experimental animals underwent placement of littermate tail nucleus pulposus ($n = 12$). Animals were evaluated throughout 1 week for mechanical allodynia by Von Frey testing, thermal hyperalgesia by heat withdrawal latency, cold allodynia by acetone testing, and gait stability by RotaRod testing. At sacrifice, immunohistochemistry was performed to identify perineural and intraneural macrophage and lymphocyte presence. Necessity of an inflammatory response was tested by attenuating systemic inflammation with intraperitoneal selenium delivery. Necessity of brain-derived neurotrophic factor (BDNF)-dependent macrophage activity was tested using a tamoxifen-induced CreER BDNF knockout system. **Results:** Mice exposed to heterotopic nucleus pulposus stimulation demonstrated substantial mechanical allodynia, thermal hyperalgesia and cold allodynia compared with controls. Intraneural macrophage infiltration was observed in this group, alongside associated autoreactive lymphocytes at the disc–nerve interface. Systemic selenium administration blocked this behavioural phenotype in the acute inflammatory phase. Knocking out inflammatory cell BDNF activity in the CreER animals eliminated macrophage migration and the painful phenotype. **Conclusion:**

Noncompressive disc herniation leads to altered behaviour in this animal disease model, with demonstrated need for intraneural macrophage migration. Strategies to decrease perineural inflammation or maintain integrity of the blood–nerve barrier may be effective in treating painful disc-herniation radiculopathy.

2.1.14

The effect of alanyl-glutamine on epidural fibrosis in a rat laminectomy model. ***K. Haugo,*** [*] ***H. Nichol,*** [†] ***D. Fourney,*** [‡] ***M. Kelly.*** [‡] **From the *University of Saskatchewan, Division of Orthopedic Surgery, Saskatoon, Sask., †University of Saskatchewan, Department of Anatomy & Cell Biology, Saskatoon, Sask., and the ‡University of Saskatchewan, Division of Neurosurgery, Saskatoon, Sask.**

Background: Epidural fibrosis may be related to recurrent pain following spinal surgery. Subsequent reoperations are more technically challenging with higher complication rates. Glutamine is a conditionally essentially amino acid that has been shown to be effective in reduction of peritoneal adhesions in a rat abdominal sepsis model. This study uses histological evaluation to investigate the effectiveness of alanyl-glutamine in minimizing epidural fibrosis in a rat laminectomy model. **Methods:** Seventy-five adult male Wistar rats were randomized into 3 groups: no surgery, laminectomy/normal saline and laminectomy/alanyl-glutamine (1g/kg). The surgical groups underwent L5/L6 laminectomy with instillation of either normal saline or alanyl-glutamine into the peridural space before wound closure. Thirty days after surgery, the animals were euthanized and the spinal columns resected. The specimens were decalcified, sectioned and stained using Masson trichrome technique. The extent and maturity of epidural fibrosis was graded by a blinded veterinary pathologist. **Results:** There was no significant difference in operating time or complication rates between groups. The χ^2 analysis demonstrated significant epidural scar formation in the rats undergoing laminectomy compared with control animals ($p < 0.001$). There was no significant difference in histological grade of fibrosis between the normal saline and alanyl-glutamine groups ($p = 0.83$). **Conclusion:** The rat laminectomy model is an effective model for epidural scar formation, and is suitable for testing potent antifibrotic therapeutic agents. Based on this study, alanyl-glutamine does not appear to have an effect in reducing epidural fibrosis at a histological level. It is is possible that alanyl-glutamine may have an effect that is not detectable using this model, in which case further studies with a more sensitive model may be indicated. However, resources may be better used elucidating the mechanism by which glutamine acts to reduce adhesions in the peritoneal model, and through a better understanding of the basic science, further studies exploiting those mechanisms can be designed.

2.1.15

Anterior lumbar interbody fusion using recombinant human bone morphogenetic protein-2: a prospective study of complications. ***G. Malham,*** [*] ***R. Parker,*** [†] ***N. Ellis,*** [†] ***C. Blecher,*** [*] ***F. Chow,*** [*] ***M. Claydon.*** [*] **From *Epworth Hospital, and †Greg Malham Neurosurgeon, Melbourne, Victoria, Australia**

Background: The use of recombinant human bone morphogenetic protein-2 (rhBMP-2) in anterior lumbar interbody fusion (ALIF) is controversial regarding the reported complication rates and cost. We aimed to assess the complication rates of performing ALIF using rhBMP-2. **Methods:** Prospective study of 131 consecutive ALIF patients performed by a single spine surgeon and a single vascular surgeon. All patients had a polyetheretherketone (PEEK) cage filled with rhBMP-2 and secured by an anterior titanium plate. Preoperative clinical data, operative details, postoperative complications, and clinical and radiographic outcomes were recorded for all patients. Clinical outcome measures included back and leg pain (visual analogue scale), Oswestry Disability Index (ODI), and SF-36 physical and mental component scores (PCS and MCS). Radiographic assessment of fusion was performed by high definition computed tomography. Male patients were screened pre- and postoperatively regarding sexual dysfunction, specifically retrograde ejaculation (RE). **Results:** Of the 131 patients, 117 (89.3%) had an ALIF at L5/S1, 9 (6.9%) at L4/5, and 5 (3.8%) at both L4/5 and L5/S1. The overall complication rate was 19.1% (25 of 131), with 17 (13.0%) experiencing minor complications and 8 (6.1%) experiencing major complications. Mean estimated blood loss per ALIF level was 115 mL. There was 1 (1.5%) incidence of RE. No significant vascular injuries occurred. No prosthesis failure occurred with the PEEK cage and separate anterior screw-plate. Back and leg pain improved 57.2% and 61.8%, respectively. ODI improved 54.3%, with PCS and MCS improving 41.7% and 21.3%, respectively. Solid interbody fusion was observed in 96.9% of patients at 12 months. **Conclusion:** ALIF with a vascular access surgeon and spine surgeon, using a separate cage and anterior screw-plate, provides a very robust and reliable construct with low complication rates, high fusion rates and positive clinical outcomes and is cost-effective. We did not experience the high rates of RE reported by other authors using rhBMP-2.

2.2.16

2-year results of a Canadian, multicentre, blinded, pilot study of a novel peptide in promoting lumbar spine fusion. ***P. Jarzem,*** [*] ***Z. Sardar,*** [*] ***D. Alexander,*** [†] ***W. Oxner,*** [†] ***S. du Plessis,*** [‡] ***A. Yee,*** [§] ***E. Wai.*** [¶] **From *McGill University Health Centre, Montréal, Que., †Queen Elizabeth II Health Sciences Centre, Dalhousie University, Halifax, NS, ‡Foothills Medical Centre, University of Calgary, Calgary, Alta., §Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont., and the ¶Ottawa Hospital, University of Ottawa, Ottawa, Ont.**

Background: Fusion failure in transforaminal lumbar interbody fusion (TLIF) procedures is a challenging problem that can lead to poor functional outcomes, ongoing back pain, dependence on pain medication and inability to return to work. B2A is a synthetic peptide that has proven efficacy in achieving fusion in animal studies, with no reports of heterotopic ossification, and may be a cheaper but safer alternative to other bone morphogenetic proteins (BMPs) while avoiding iliac crest bone graft (ICBG) harvesting morbidity. The purpose of this study was to assess the safety and effectiveness of B2A peptide enhanced ceramic granules in achieving fusion at 24 months after surgery. The 1-year data was presented at the Canadian Spine Society meeting previously. **Methods:** This is a multicentre, Canadian, prospective pilot study. Skeletally mature patients (18–70 years old) with degenerative lumbar disease at L2-S1 requiring single level transforaminal

lumbar interbody fusion were randomized to 3 groups: ICBG, B2A concentration 150 µg and B2A concentration 750 µg; B2A was combined 1:1 with locally derived autograft before implanting. Twenty-four patients (9 control, 8 B2A 150, 7 B2A 750; 10 males, 14 females) were enrolled between 2009 and 2010. The patients had preoperative screening low back pain or leg pain of at least 6 cm using a 10 cm visual analogue back pain scale (VAS) and had at least 20 points (40%) on the Oswestry Disability Index (ODI) questionnaire. Postoperative rehabilitation plans were similar among patients. Outcome measures included ODI, VAS, and fusion as assessed by computed tomography and dynamic flexion/extension X-rays (all interpreted by an independent, blinded radiologist). Patients were evaluated at 6 weeks and 3, 6 and 12 months after surgery. **Results:** Fusion at 6 months was 33%, 38% and 71% for ICBG, low and high dose, respectively. At 12 months, fusion was 78%, 50%, and 100% for ICBG, Prefix 150 and 750 respectively. This changed to 78%, 63% and 100% at 24 months for ICBG, Prefix 150 and 750 respectively. The mean improvement in ODI from preop at 12 months was 36.5 for ICBG, 33.4 for Prefix 750 and 20.1 for Prefix 150. At 24 months after surgery, the mean improvement in ODI compared with preop was 42.0 for ICBG, 32.9 for Prefix 750 and 21.2 for Prefix 150. There were no significant differences in serum chemistry between groups. No subjects developed antibodies to B2A. Procedure related complications included 1 adjacent level infection needing reoperation (Prefix 750) 1 wound infection that was treated medically (Prefix 150). **Conclusion:** Prefix provides a safe alternative to ICBG and avoids donor site morbidity. B2A 750 showed superior fusion rate to autograft at 24 months. Both Prefix groups and autograft were equivalent in improving ODI at all time points up to 24 months

2.2.17

Comparative outcomes and cost-utility following surgical treatment of focal lumbar spinal stenosis compared with osteoarthritis of the hip or knee: long-term change in health-related quality of life. ***Y.R. Rampersaud,*‡ S.J. Lewis,*‡ J.R. Davey,*† R. Gandhi,*† N. Mahomed.*†***
From the *Division of Orthopaedic Surgery and Neurosurgery, Department of Surgery, University of Toronto, †Arthritis Program, Toronto Western Hospital, University Health Network, University of Toronto, and the ‡Spinal Program, Krembil Neuroscience Center, Toronto Western Hospital University Health Network, University of Toronto, Toronto, Ont.

Background: To assess whether improvements in health related quality of life (HRQoL) following surgical management of focal lumbar spinal stenosis (FLSS) with or without spondylolisthesis is sustainable over the long-term compared with that of hip and knee arthroplasty (THA/TKA) for osteoarthritis. **Methods:** A single-centre, retrospective longitudinal matched cohort study of prospectively collected outcomes at a minimum follow-up of 5 years. Cohorts: primary 1–2 level spinal decompression with or without instrumented fusion for FLSS (n = 99), THA (n = 99) and TKA (n = 99). Postoperative change from baseline to last follow-up in SF-36 physical (PCS) and mental (MCS) component summary scores between groups was the primary outcome measure. **Results:** Mean follow-up in months (% follow-up) FLSS/THA/TKA was 80.5 ± 16.04 (79%)/94.6 ± 16.62 (92%)/80.6 ± 16.84 (85%), respectively (range 5–10 yr). Number of patients having undergone revision, including those lost to follow-up, FLSS/THA/TKA was n = 20 (20.2% same site [n = 7] and adjacent segment [n = 13]) requiring 27 operations/n = 3 (3%) requiring 5 operations/n = 8 (8.1%) requiring 12 operations ($p < 0.01$). The average time to first revision was 56/65/43 months, respectively. Mean postoperative PCS ($p < 0.0001$) and MCS ($p < 0.02$) improved significantly and was durable for all groups at the last follow-up. The mean change from baseline PCS/MCS to last follow-up, was 8.5/6.4, 12.3/7.0 and 8.3/4.9 for FLSS, THA and TKA, respectively. Adjusting for baseline age, sex, body mass index, PCS and MCS, there was a strong trend in favour of greater sustained change in the PCS of THA over FLSS ($p = 0.07$) and TKA ($p = 0.08$). There was no difference in the degree of change in PCS between FLSS and TKA ($p = 0.95$) and MCS between all 3 cohorts ($p > 0.1$). **Conclusion:** Despite a higher revision rate, patients undergoing surgery for FLSS can expect a comparable long-term (7–8 yr) average improvement in HRQoL from baseline compared with their peers undergoing TKA and to a lesser extent THA.

2.2.18

Changes in objectively measured walking performance, function, and pain following surgery for spondylolisthesis and lumbar spinal stenosis. ***C. Tomkins-Lane,* R. Hu,† K. Thomas,† C. Hepler,* K. Choi,* K. Rowed,* A. Haig.‡***
From *Mount Royal University, †University of Calgary, Calgary, Alta., and the ‡University of Michigan, Ann Arbor, Mich.

Background: Goals of spine surgery include relief of symptoms and increased function. In particular, performance (actual function in the usual environment) has recently been identified as an important outcome. While existing studies suggest that surgery improves pain and function, it remains to be seen whether such changes translate into increased performance in the community. **Methods:** All subjects were over 50, and undergoing decompression with single level fusion for spondylolisthesis and associated lumbar spinal stenosis (LSS). One week prior, and 6 months post-surgery subjects wore an activity monitor for 7 days, completed the Self-Paced Walking Test and a questionnaire. Walking performance was measured with activity counts and steps/day. Maximum continuous activity was defined as the maximum number of consecutive minutes above "light intensity" activity (> 100 counts/min). **Results:** Subjects (n = 17) had a mean age of 66.5 ± 7.4 years and 50% were male. Significant improvements were seen at 6 months in self-reported function, walking capacity and pain, as measured by the ODI, Swiss Spinal Stenosis Questionnaire and pain scales ($p < 0.05$). Measured walking capacity improved (767–1741 m), as did total activity (789 357 activity counts/week to 3 343 300), steps per day (3986–4376), and maximum continuous activity (5.6–6.7 min); however, none of these changes was statistically significant. **Conclusion:** Significant changes in self-reported function, walking capacity and pain were observed following surgery for spondylolisthesis with LSS. However, improvements in objectivity measured walking performance did not reach statistical significance. While a larger sample may show significant changes in performance, current results suggest that perceived improvements may not be fully reflected in changes in daily function. Given that improved function is a major goal of surgery, there is a need to further investigate the

impact of interventions on performance, and to consider what the outcomes we choose are actually measuring.

2.3.19

A prospective multicentre observational data-monitored study of minimally invasive fusion to treat degenerative lumbar disorders: complications and outcomes at 1-year follow-up. ***N. Manson,*†* ***K. Lam.*‡§** **From *Dalhousie University, Saint John, Nfld., †Horizon Health Network, Saint John, Nfld., ‡London Bridge Hospital, and §Guy's and St Thomas' NHS Foundation Trust, London, UK**

Background: To evaluate minimally invasive posterior lumbar interbody fusion (MILIF) for degenerative lumbar disorders (DLD) in a multicentre 1-year prospective observational study (NCT01143324). **Methods:** Two hundred and fifty-two patients enrolled by 19 centres in 14 countries underwent 1- (83%) or 2-level (17%) MILIF (TLIF: 95%; PLIF: 5%) for treatment of leg pain (52%), back pain (39%) or claudication (9%) due to DLD, including spondylolisthesis (53%), stenosis (71%), and/or disc pathology (94%). Surgeons were required a minimum pre-study experience of 30 MILIF cases. Patient demographics, intraoperative data, complications, time to first ambulation, time to study-defined recovery, surgical duration, blood loss, fluoroscopy time and adverse events (AEs) were recorded. Outcome scores (visual analogue scale [VAS] back and leg, Oswestry Disability Index [ODI], EQ-5D) were assessed preoperatively and at defined times through 12 months postop. **Results:** Ninety-nine percent (249 of 252) follow-up at 4 weeks and 93% (233 of 252) at 12 months. One-level surgery occurred at L4–5 or L5-S1 in 91%, 2-level surgery at L4-S1 in 74%. Mean surgical duration, blood loss, fluoro-time were 128 versus 182 minutes, 164 versus 233 mL, and 115 versus 154 seconds in 1- and 2-level cases, respectively. Mean time to first ambulation was 1.3 days, and study-defined recovery was 3.2 days. All scores improved significantly ($p < 0.0001$) between preop, 4 weeks and 12 months (VAS back 6.2, 2.9, 2.9; VAS leg 5.9, 2.5, 2.2; ODI% 45.5, 34.5, 22.4; EQ-VAS 52.9, 65.4, 71.0; EQ-5D index 0.34, 0.61, 0.71). There was a constant improvement of EQ-5D subscales and pain medication reduction to 12 months. Fifty AEs in 39 patients (15.5%) were attributed to surgery, approach, or device, 9 of which were considered serious. Three AEs were attributed to the minimally invasive approach (1 serious). No deep surgical site infections and 7 reoperations occurred. **Conclusion:** This is the largest international prospective multicentre observational study of MILIF to date. MILIF demonstrated favourable clinical results with early and sustained improvement in outcomes and low major perioperative morbidity.

2.3.20

Assessment and classification of subsidence in lateral interbody fusion using serial computed tomography. ***G. Malham,** ***R. Parker,†* ***C. Blecher,** ***K. Seex.‡*** **From *Epworth Hospital, †Greg Malham Neurosurgeon, Melbourne, Victoria, Australia, and ‡Macquarie University, Sydney, New South Wales, Australia**

Background: The objectives of this study were to: (i) assess the rate of subsidence in extreme lateral interbody fusion (XLIF) by computed tomography (CT); (ii) distinguish between early cage subsidence (ECS) and delayed cage subsidence (DCS); (iii) propose a descriptive method to classify types and grades of subsidence; and (iv) discuss techniques to mitigate the risk of subsidence after XLIF. **Methods:** One hundred consecutive patients were treated with XLIF by a single surgeon. The ECS was determined if subsidence was evident on day 2 postoperative CT and likely the result of direct vertebral end plate injury. The DCS was determined if subsidence was detected on subsequent CT scans. End plate breach was categorized as caudal (superior end plate) and/or cranial (inferior end plate), and ipsilateral, contralateral, or bilateral, with respect to the side of cage insertion. Radiographic subsidence was measured from the vertebral end plate to the caudal or cranial margin of the cage, in millimetres. Patient-reported outcome measures included visual analogue scale, Oswestry Disability Index and SF-36 physical and mental component scores. **Results:** The radiographic subsidence rate was 11% of patients and 9% of levels; with 3% exhibiting clinical subsidence (ECS: 2 patients in 2 levels, DSC: 9 patients in 10 levels). Three types of subsidence were evident on coronal and sagittal CT in the DCS levels: caudal contralateral in 20%, caudal bilateral in 60%, and both end plates bilaterally in 20%. The mean subsidence in the DCS levels was 2.7 mm. The 2 ECS cases were caudal bilateral subsidence. **Conclusion:** Radiographic subsidence was categorized using descriptors for location of subsidence and severity. To protect patients from subsidence in XLIF the surgeon needs to take care with the caudal end plate during cage insertion. If a caudal bilateral end plate breach is detected supplemental posterior fixation is recommended.

2.3.21

Predictors of willingness to undergo spinal and orthopaedic surgery after surgical consultation. ***Y.R. Rampersaud,*†* ***A.V. Perruccio,†* ***R. Gandhi,*†* ***UHN Arthritis Program.†*** **From the *Division of Orthopaedic Surgery and Neurosurgery, Department of Surgery, University of Toronto, and the †Arthritis Program, Toronto Western Hospital University Health Network, University of Toronto, Toronto, Ont.**

Background: This study aimed to identify factors affecting patients' willingness to undergo spinal and orthopaedic surgery following surgical consultation. **Methods:** Consecutive patients referred for surgical consultation were recruited between 2008 and 2010. All participants completed a preconsultation questionnaire and those deemed surgical candidates by the surgeon also completed a postconsultation questionnaire. Primary analysis: Odds of being unwilling to undergo surgery postconsultation were examined using multivariable logistic regression. **Results:** A total of 1954 patients participated (51% male, with 23% spine, 39% hip/knee, 20% shoulder/elbow and 18% foot/ankle consultations). A total of 52.3% were willing to undergo surgery both pre- and post-consultation; 5.2% were unwilling to have surgery both pre- and post-consultation; 28% changed from unwilling to willing to have surgery following consultation; and 15% changed from willing to unwilling. Spine patients had worse SF-36 scores overall and were more likely to report uncertainty regarding risk and success of surgery. Multivariable logistic regression results showed, controlling for a number of covariates, significant predictors of unwillingness to undergo surgery were: perception of "high" surgical risk (odds ratio [OR] 9.50) or uncertainty about

surgical risk (OR 2.72) compared with a perception of "no" or "moderate" risk; perception of "moderate" surgical success (v. "high" success) (OR 3.40); patients who were dissatisfied with the information provided by the surgeon had higher odds of refusing surgery after consultation (OR 2.35); and less pain (i.e., higher score) on the bodily pain subcomponent of SF-36 (OR 1.03). Age, sex, education, obesity, Charlson Comorbidity Index, and previous surgery did not significantly predict willingness to undergo surgery. **Conclusion:** While the findings from this study appear intuitive, they suggest that simple and targeted improvements in the surgeon's approach to informal shared decision-making and patient education during consultation may positively affect patient decision making toward accepting surgery for those deemed candidates.

2.4.22

Indirect foraminal decompression is independent of facet arthropathy in extreme lateral interbody fusion. ***G. Malham,* N. Ellis,† R. Parker,† B. Goss,‡ C. Blecher,* Z. Ballok.** **From *Epworth Hospital, Melbourne, †Greg Malham Neurosurgeon, and ‡NuVasive Australia and NZ Pty Ltd., Melbourne, Victoria, Australia**

Background: There is debate on the amount of indirect decompression that can be achieved by insertion of a wide footprint interbody device in extreme lateral interbody fusion (XLIF). The degree of facet arthropathy is considered to restrict the distraction and hence the achievement of neural decompression. The aim of this study was to correlate the amount of indirect foraminal decompression in a consecutive series of XLIF patients with the degree of facet arthropathy, measured on preoperative and postoperative computed tomography (CT). **Methods:** A prospective database of consecutive patients undergoing XLIF was retrospectively analyzed. The posterior disc height, foraminal height and cross-sectional foraminal area were measured on CT scans taken preoperatively and 2 days postoperatively. The digital measurements obtained were correlated with the degree of facet arthropathy on preoperative CT coregistered with isotope bone scans. **Results:** Fifty-two patients underwent 79 levels of XLIF. Average age was 66.4 years and 34 (65.4%) were female. Surgery resulted in significant increases in posterior disc height (3.0–5.7 mm [89.0% increase], $p < 0.0001$), foraminal height (1.4–1.7 cm [38.0% increase], $p < 0.0001$) and foraminal area (1.1–1.4 cm^2 [45.1% increase], $p < 0001$). These increases were independent of the degree of facet arthropathy. **Conclusion:** Significant amounts of indirect decompression can be achieved in XLIF patients independent of the degree of facet arthropathy.

2.4.23

Cervical artificial disc replacement with ProDisc-C: clinical and radiographic outcomes with long-term follow-up. ***G. Malham,* R. Parker,† N. Ellis,† P. Chan,‡ D. Varma.‡§*** **From *Epworth Hospital, †Greg Malham Neurosurgeon, ‡The Alfred Hospital, and §Monash University, Melbourne, Victoria, Australia**

Background: Cervical artificial disc replacement (ADR) is indicated for the treatment of severe radiculopathy permitting neural decompression and maintenance of motion. We aimed to evaluate the clinical and radiographic outcomes in cervical ADR patients using the ProDisc-C device with a 5–9-year follow-up. **Methods:** Data were collected through a prospective registry, with retrospective analysis performed on 24 consecutive patients treated with cervical ADR by a single surgeon. All patients underwent 1- or 2-level ADR with the ProDisc-C device. Outcome measures included neck and arm pain (visual analogue scale), disability (neck disability index [NDI]), complications and secondary surgery rates. Flexion–extension cervical X-rays were performed to assess range of motion (ROM) of the device and adjacent segment disease (ASD). **Results:** Average follow-up was 7.7 years. Neck and arm pain improved 60% and 79%, respectively, and NDI had an improvement of 58%. There were no episodes of device migration or subsidence. Mean ROM of the device was 6.4°. Heterotopic ossification (HO) was present in 7 patients (37%). Radiographic ASD below the device developed in 4 patients (21%) (1 single level and 3 2-level ADR). No patient required secondary surgery (repeat operations at the index level or adjacent levels). Fourteen out of 19 patients (74%) were able to return to employment, with a median return-to-work time of 1.3 months. **Conclusion:** The ProDisc-C device for cervical ADR is a safe option for patients providing excellent clinical outcomes, satisfactory return to work rates and maintenance of segmental motion despite radiographic evidence of HO and ASD on long-term follow-up.

2.4.24

Tantalum trabecular metal implants in anterior cervical corpectomy and fusion. ***V. King, A. Swart, M. Winder.*** **St Vincent's Hospital, Sydney, New South Wales, Australia**

Background: Anterior cervical decompression for 2 or more cervical spondylotic levels can be performed either using multiple anterior cervical discectomy and fusion (ACDF) or anterior cervical corpectomy and fusion (ACCF). Variable options for ACCF implants exist but to date there is no clinical data for the use of tantalum trabecular metal implants (TTMI) for ACCF. Our objective was to evaluate the clinical and radiological outcomes of patients undergoing ACCF with TTMI. **Methods:** Patients who underwent ACCF with TTMI between 2011 and 2013 at our institution were evaluated. Patients were reviewed prospectively at 0, 3, 6, 12 and 24 months postoperatively. Clinical outcome was assessed with the Neck Disability Index (NDI). Radiological outcome was assessed with lateral cervical X-ray in which cervical lordosis and graft subsidence were measured. **Results:** Data from 11 patients were analyzed. The average preoperative NDI was 45%. Postoperatively, average NDIs were 18%, 13% and 10% for 6, 12 and 24 months, respectively. Cervical lordosis (Cobb angle) across the fused segment was 5.2° (± 4.24°) immediately postoperatively and at 24 months postoperatively, 5.0° (± 4.24°). Significant graft subsidence (anterior, cranial and caudal) was observed to occur at 6-month follow-up and continued throughout follow-up. Anterior subsidence occurred more in the first 12 months postoperatively than in the following 12 months (2.36 v. 0.69 mm; $p < 0.05$). Posterior and cranial subsidence also occurred, at an average of 1.12 mm ($p = 0.13$) and 1.52 mm ($p = 0.05$), respectively. **Conclusion:** The ACCF patients treated with TTMIs demonstrated stable cervical lordosis over 2 years of follow-up. Measures of subsidence appeared to decrease over time but continued throughout follow-up. Nevertheless, patients experienced improved clinical outcomes over the follow-up period.

Friday, February 28, 2014

3.1.25

Hemangiomas of the spine: results of surgical management and prognostic variables for local recurrence and mortality in a multicentre study. ***C. Goldstein,[*] P. Pal Varga,[†] Z. Gokaslan,[‡] S. Boriani,[§] A. Luzzati,[¶] L. Rhines,[**] C. Fisher,[††] D. Chou,[‡‡] R. Williams,[§§] M. Dekutoski,[¶¶] N. Quraishi,[***] C. Bettegowda,[‡] N. Kawahara,[†††] M. Fehlings.[*]*** **From the *University of Toronto, Toronto Western Hospital, Toronto, Ont., †Buda Health Centre, National Center for Spinal Disorders, Budapest, Hungary, ‡Johns Hopkins University School of Medicine, Baltimore, Md., §Istituto Ortopedico Rizzoli, Bologna, Italy, ¶Instituto Ortopedico Galeazzi, Milan, Italy, **University of Texas, MD Anderson Cancer Center, Houston, Tex., ††University of British Columbia, Vancouver General Hospital, Vancouver, BC, ‡‡University of California San Francisco, San Francisco, Calif., §§Queensland University of Technology, Brisbane Spine Reference Centre, Brisbane, Australia, ¶¶The Centre for Orthopedic Research and Education, Sun City West, Ariz., ***Nottingham University Hospital NHS Trust, Queens Medical Centre, Nottingham, UK, and †††Kanazawa Medical University, Kahoku-gun, Japan**

Background: Optimal surgical treatment of, and risk factors for local recurrence and mortality associated with, symptomatic spinal hemangiomas remain unclear. This multicentre cohort study aims to quantify rates of local recurrence and mortality following surgical treatment of symptomatic spinal hemangiomas and to identify prognostic variables for local disease control and death. **Methods:** AOSpine Knowledge Forum Tumor investigators created an ambispective database of surgically treated patients with symptomatic spinal hemangiomas. Patient data pertaining to demographics, clinical presentation, diagnosis, treatment, cross-sectional survival, local recurrence, and perioperative morbidity were collected. Tumors were classified according to Enneking and Weinstein-Boriani-Biagini. Descriptive statistics were summarized and Kaplan–Meier curves illustrated mortality and recurrence. Fisher exact and log-rank tests identified prognostic variables for recurrence and mortality. **Results:** Between 1996 and 2012, 68 patients (mean age 51 yr, standard deviaion [SD] 16), 43 females and 25 males, underwent surgical treatment for a spinal hemangioma with 23% (n = 13) classified as benign aggressive. Epidural tumour extension was present in 55% of patients (n = 33). Pain was a presenting symptom in 82% (n = 54), 31% (n = 20) had a pathologic fracture, and 37% (n = 24) were neurologically compromised. Twenty-three patients (35%) underwent preoperative embolization. Enneking appropriate surgery was performed in 79% of patients (n = 44). Adjuvant radiotherapy was employed in 10% of patients (n = 7). The local recurrence rate was 3% (n = 2) with no recurrences in patients undergoing marginal or wide resection. Mortality due to spinal hemangioma was not observed during the study period (mean follow-up 3.9 yr, SD 3.8). Prior subtotal intralesional resection was performed in 1 of the 2 patients who had a local recurrence. **Conclusion:** This is the largest multicentre surgical cohort of spinal hemangiomas. While symptomatic spinal hemangiomas frequently present with epidural disease and neurologic compromise, excellent rates of local control and long-term survival can be obtained when strict oncologic treatment principles are followed during the index surgery.

3.1.26

Chondrosarcomas of the spine: prognostic variables for local recurrence and mortality in a multicentre study. ***C. Fisher,[*] A. Versteeg,[***] S. Boriani,[†] P. Pal Varga,[‡] M. Dekutoski,[¶] A. Luzzati,[**] Z. Gokaslan,[¶¶] R.P. Williams,[††] J. Reynolds,[‡‡] M. Fehlings,[§] C. Bettegowda,[¶¶] L. Rhines.[§§]*** **From the *University of British Columbia and Vancouver General Hospital, Vancouver, BC, †Rizzoli Institute, Bologna, Italy, ‡National Center for Spinal Disorders and Buda Health Centre Ltd., Budapest, Hungary, §University of Toronto and Toronto Western Hospital, Toronto, Ont., ¶The CORE Institute, Sun City West, Ariz., [6]Istituto Ortopedico Galeazzi, Milano, Italy, [7]Princess Alexandra Hospital, Brisbane, Queensland, Australia, [8]Oxford University Hospital NHS Trust, Oxford, UK, [9]MD Anderson Cancer Centre and the University of Texas, Houston, Tex., ¶¶Johns Hopkins University School of Medicine, Baltimore, Md., and ***University Medical Center Utrecht, Utrecht, the Netherlands**

Background: The aim of this multicentre cohort study was to identify key prognostic variables, including specimen margins, for local recurrence and mortality following surgical intervention for spinal chondrosarcomas. **Methods:** AOSpine Knowledge Forum Tumor developed a multicentre ambispective database of surgically treated patients with spinal chondrosarcoma. Data pertaining to demographics, diagnosis, treatment, survival, and local recurrence were collected. Tumors were classified according to the Enneking classification. Patients were analyzed in 2 cohorts; Enneking appropriate (EA) and Enneking inappropriate (EI). Enneking appropriate was defined by the final pathology margin matching the Enneking recommended surgical margin and EI by not matching. **Results:** Between 1987 and 2012, 141 patients (mean age 47 ± 16 yr) underwent, surgical treatment for a spinal chondrosarcoma. Enneking appropriate surgery was performed in 91 patients (71%). Eighteen patients (20%) suffered a local recurrence in the EA group and 19 (51%) in the EI group. Enneking inappropriate approach significantly increased the risk for local recurrence. Thirty-eight patients died during the study (mean follow-up 2.2 yr); factors associated with increased overall survival were younger age at surgery (p = 0.001), low grade tumours (p = 0.048), and involvement of 1 or 2 vertebral levels (p = 0.013). Local recurrence was related to mortality, with an odds ratio of 8.4, but mortality did not reach significance related to EA and EI margins. **Conclusion:** Primary spinal chondrosarcomas are rare. Best available evidence is small case series, thus making it difficult to determine optimal management and prognosis. This is the largest multicentre cohort of spinal chondrosarcomas. EI surgery correlated to increased rates of local recurrence. This robust correlation strongly mandates surgeons to perform EA resection for spinal chondrosarcomas.

3.1.27

Risk factors for recurrence of surgically treated spine schwannomas: analysis of 169 patients from a multicentre

international database. *M. Fehlings,[*†] J. Zamorano,[*] A. Nater,[*‡] L. Tetrault,[†‡] P. Varga,[§] Z. Gokaslan,[¶] S. Boriani,[**] C. Fisher,[††] L. Rhines,[‡‡] C. Bettegowda,[¶] N. Kawahara,[§§] D. Chou.[¶¶]* From the *Department of Surgery, Division of Neurosurgery and Spinal Program, Toronto Western Hospital, University of Toronto, †Toronto Western Research Institute and Krembil Neuroscience Centre, University Health Network, ‡Institute of Medical Science, University of Toronto, Toronto, Ont., §National Center for Spinal Disorders and Buda Health Center, Budapest, Hungary, ¶Department of Neurosurgery, John Hopkins University School of Medicine, Baltimore, Md., **Department of Degenerative and Oncological Spine Surgery, Rizzoli Institute, Bologna, Italy, ††Division of Spine, Department of Orthopaedics, University of British Columbia and Vancouver Coastal Health, Vancouver, BC, ‡‡Department of Neurosurgey, MD Anderson Cancer Center, The University of Texas, Houston, Tex., §§Department of Orthopaedic Surgery, Kanazawa Medical University, Kahoku-gun, Japan, and the ¶¶Department of Neurosurgery, University of California San Francisco, San Francisco, Calif.

Background: Schwannomas account for up to 30% of all intraspinal tumours. Total resection is the gold standard for patients with initial sensory or motor deficits. Local recurrence is reported to be around 5% and it usually occurs several years after the surgery. The objective of this study was to analyze a multicentre database of patients operated for spine schwannomas to identify risk factors for local recurrence. **Methods:** Retrospective analysis of 169 patients (age > 18 yr) from the AOSpine Multicentre Primary Spinal Tumors Database, who underwent surgery for a spine schwannoma. Rates of tumour recurrence and time to recurrence were quantified. The predictive value of various clinical factors, including age, gender, tumour size, affected spinal segments, type of surgery and extent of disease as defined by the Weinstein–Boriani–Biagini (WBB) classification system, was assessed. Univariate and multivariate analysis was performed. **Results:** Nine patients experienced local recurrence (5.3%) at a time range of 81 to 1518 days. These patients were on average younger (39.33 ± 15.58 v. 47.01 ± 15.29), although this relationship did not reach significance (hazard ratio [HR] 0.97, $p = 0.16$). Thirteen, ten and seven percent of patients with cervical, sacral and lumbar disease, respectively, experienced tumour recurrence compared with zero percent of thoracic patients ($p = 0.18$). The location of the tumour ($p = 0.25$), whether epidural, intradural or both, and the number of WBB sectors involved (HR 1.03, $p = 0.79$) were not significantly related to recurrence. The actual size of the tumour was significantly larger in patients with recurrence (6.97 ± 4.66 v. 3.81 ± 3.34) (HR 1.16, $p = 0.028$), with the extent in the cranial-caudal direction posing the greatest hazard (HR 1.324, $p = 0.0018$). With respect to surgical technique, patients receiving a complete resection (3.6%) had a significantly lower risk of recurrence than those treated with an intralesional subtotal procedure (13.9%, $p = 0.047$). **Conclusion:** Local recurrence after schwannoma resection appears to be determined mainly by the size of the tumour and the extension of the surgical resection.

3.2.28

Survival pattern and the effect of surgery on health related quality of life and functional outcome in patients with metastatic epidural spinal cord compression from lung cancer — the AOSpine North America prospective multicentre study. *C. Fisher,[*] M. Fehlings,[†] B. Kopjar,[‡] A. Vaccaro,[§] P. Arnold,[¶¶] J. Schuster,[***] J. Finkelstein,[¶] L. Rhines,[**] M. Dekutoski,[††] Z. Gokaslan,[‡‡] J. France.[§§]* From the *University of British Columbia and Vancouver General Hospital, Vancouver, BC, †University of Toronto and Toronto Western Hospital, Toronto, Ont., ‡University of Washington, Seattle, Wash., §Thomas Jefferson University, Philadelphia, Pa., ¶Sunnybrook Health Sciences Centre, Toronto, Ont., **University of Texas and MD Anderson, Houston, Tex., ††The CORE Institute, Sun City West, Ariz., ‡‡John Hopkins University, Baltimore, Md., §§West Virginia University, Morgantown, W. Va., ¶¶University of Kansas, Kansas City, Kans., and the ***Hospital of the University of Pennsylvania, Philadelphia, Pa.

Background: Many patients with metastatic epidural spinal cord compression (MESCC) secondary to lung cancer have a relatively short life expectancy and thus choosing which patients are appropriate for surgery is a significant challenge. The primary purpose of this study is to assess survival patterns and prognostic factors in lung cancer patients receiving surgical treatment for MESCC. Secondary outcomes are to assess health-related quality of life (HRQOL) outcomes in this patient population. **Methods:** A prospective multicentre, cohort study. Patients were followed at predetermined visits up to 24 months. There were 34 patients with MESCC secondary to lung cancer. Outcomes were assessed using visual analogue scale (VAS) pain assessments, American Spinal Injury Association (ASIA) scale, Oswestry Disability Index (ODI), SF-36v2, and EuroQol-5D (EQ-5D). Changes in outcomes were evaluated by paired *t* tests. Survival was modelled by Kaplan–Meier product moment nonparametric estimates. **Results:** The average age was 60 years (SD 10, range 38–79) with 56% males. Median survival was 151 days (95% CI 64–240). Twenty-five percent survived less than 58 days and only 25% survived longer than 314 days. Prognostic factors are currently being assessed. Baseline status was poor. The VAS was 7.1 (SD 2.5); ODI 63.6 (SD 20.5); SF36v2 Physical Component Score (PCS) 28.9 (SD 8.8); and EQ-5D was 0.33 (SD 0.25). 42% had normal AIS grade "E," 39% "D," 14% "C," 3% "B" and 0% "A." Patients who survived 3 months experienced significant improvement in pain, function and health utility. At 3 months, VAS improved 2.1 (SD 3.2, $p < 0.01$); ODI f 17.5 (SD 25.4; $p < 0.01$) and EQ5D for 0.19 (SD 0.27, $p < 0.01$). The improvement in PCS was 0.69 (SD 10.9, $p = 0.66$). **Conclusion:** Lung cancer patients with MESCC have distinct survival patterns. Most survive less than 3 months, but there is a distinct group who lives greater than 3 months with excellent improvement in HRQOL.

3.2.29

A biomechanical assessment of kyphoplasty as a stand-alone treatment in a human cadaveric burst fracture model. *E. Wong,[*†] C. Whyne,[*†] D. Singh,[*†] M. Ford.[*†]* From the *Sunnybrook Health Sciences Centre, and the †University of Toronto, Toronto, Ont.

Background: To determine whether kyphoplasty is an adequate stand-alone treatment for restoring biomechanical stability in the spine after experiencing high energy vertebral burst fractures.

Methods: Young cadaveric spines (15–50 years old) were divided into motion segments consisting of 3 intact vertebra separated by 2 intervertebral discs (T11-L1 and L2-L4). Mechanical testing in axial, flexion/extension, lateral bending and torsion was performed on each specimen in an intact state, following an experimentally simulated burst fracture and post-kyphoplasty. CT imaging was used to confirm the burst fractures and quantify cement placement. **Results:** Between the intact and burst fractured states significant decreases in stiffness were seen in all loading modes (63%–69%). Burst fracture increased the average angulation of the vertebral end plates 147% and decreased vertebral body height by an average of 40%. Post-kyphoplasty, only small recoveries in stiffness was seen in axial, flexion/extension and lateral bending (4%–12%), with no improvement in torsional stiffness. Large angular deformations (85%) and height loss (31%) remained post-kyphoplasty as compared with the intact state. **Conclusion:** Between the intact and burst fractured states significant decreases in stiffness were seen in all loading modes (63%–69%). Burst fracture increased the average angulation of the vertebral end plates 147% and decreased vertebral body height by an average of 40%. Post-kyphoplasty, only small recoveries in stiffness was seen in axial, flexion/extension and lateral bending (4%–12%), with no improvement in torsional stiffness. Large angular deformations (85%) and height loss (31%) remained post-kyphoplasty as compared with the intact state.

3.2.30

What is safer in incompetent vertebrae with posterior wall defects, kyphoplasty or vertebroplasty: a study in vertebral analogs. ***Z. Sardar,[*] W. Aldebeyan,[*] J. Ouellet,[*] T. Steffen,[†] L. Beckman,[†] M. Weber,[*] P. Jarzem.[*]*** **From *McGill University Health Centre, and the †Orthopaedic Research Laboratory, Montréal, Que.**

Background: Kyphoplasty and vertebroplasty are commonly used procedures for providing pain relief in fractures due to osteoporosis or cancer. However, cement leakage during these procedures, especially in the case of a cancer induced posterior vertebral wall defect can be a major source of morbidity and degraded outcome. The purpose of our study was to analyze the volume of cement that can be safely injected before having posterior cement extravasation using the vertebroplasty or the balloon kyphoplasty techniques with either medium or high viscosity cement. **Methods:** Forty artificial vertebral analogues made of polyurethane with osteoporotic cancellous matrix representing the L3 vertebrae were used for this study that were divided into 4 groups of 10 vertebrae each. The 4 groups tested were: low viscosity cement injected using vertebroplasty, high viscosity cement injected using vertebroplasty, low viscosity cement injected using balloon kyphoplasty, and high viscosity cement injected using balloon kyphoplasty. The procedures were carried out under fluoroscopic guidance. Injection was stopped when the cement started protruding from the posterior wall defect. The main outcome measured was the volume of cement injected safely into a vertebra before leakage through the posterior wall defect. **Results:** The highest volume of cement injected was in the vertebroplasty group using high viscosity cement which was almost twice that injected in the other 3 groups. One-way ANOVA comparing the 4 groups showed a statistically significant difference ($p < 0.0001$). Post-hoc analysis showed a statistically significant difference in the volumes when comparing the high viscosity vertebroplasty groups with all the other 3 groups respectively. However, there was no statistically significant difference in the volume of cement injected between the other 3 groups. **Conclusion:** High viscosity cement injected using vertebroplasty delivers significantly more cement and fills the vertebral body more uniformly when compared with balloon kyphoplasty in osteoporotic vertebrae with a posterior wall defect.

3.3.31

Feasibility of recruiting subjects for acute spinal cord injury (SCI) clinical trials in Canada. ***S.D. Christie,[*] B.K. Kwon,[†] H. Ahn,[‡] C.S. Bailey,[§] M.G. Fehlings,[¶] D.R. Fourney,[**] D. Gagnon,[††] E.C. Tsai,[‡‡] D. Tsui,[§§] S. Parent,[¶¶] J. Chen,[***] M. Dvorak,[†††] V.K. Noonan,[†***] C.S. Rivers[***]; RHSCIR Network.*** **From *Dalhousie University, Halifax, NS, †University of British Columbia, Vancouver, BC, ‡St. Michael's Hospital, University of Toronto Spine Program, Toronto, Ont., §Western University, London, Ont., ¶Division of Neurosurgery and Spinal Program, University of Toronto, Toronto, Ont., **University of Saskatchewan, Saskatoon, Sask., ††École de réadaptation, Faculté de medicine, Université de Montréal, Montréal, Que., ‡‡The Ottawa Hospital, Ottawa Hospital Research Institute, University of Ottawa, Ottawa, Ont., §§Hamilton Health Sciences, Hamilton, Ont., ¶¶Université de Montréal, Montréal, Montréal, Que., ***Rick Hansen Institute, Vancouver, BC, and †††Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, Vancouver, BC**

Background: Trials of neuroprotective/neuroregenerative therapies for acute traumatic spinal cord injury (tSCI) require considerable time and resources to complete. Given the low incidence of tSCI at any single centre, multicentre collaborations are required to complete these trials in a timely fashion. Our goal was to determine the utility of using the Rick Hansen Spinal Cord Injury Registry (RHSCIR) to predict the feasibility of conducting multicentre tSCI trials within Canada. **Methods:** The RHSCIR prospectively recruited patients with tSCI between 2004 and 2013 from 18 Canadian acute care centres. Complete records of registry participants were reviewed to assess potential for trial participation. Characteristics that typically preclude trial participation (e.g., age < 18 yr or > 75 yr, penetrating injuries) were quantified. Key eligibility criteria (injury-to-hospital time, admission neurology) from 6 published/ongoing clinical trials (Surgical Timing in Acute Spinal Cord Injury Study [STASCIS] [< 24 h, C2-T1, surgery within 7d], minocycline [< 11 h, C0-C8], riluzole [< 12 h, C4–8, ASIA injury score (AIS) A, B, C], sygen [C1-T9, lower extremity motor score ≤ 15], cethrin [C4-T12, AIS A, surgery within 7 d], and NOGO [C5-T11, AIS A]) were applied to the cohort. We also identified indicators of multi-trauma/poor health, which would reduce eligibility for clinical trials (Glasgow Coma Scale [GCS] < 13, serious comorbidities [e.g., AIDS, dementia]). **Results:** Of 2751 RHSCIR participants, the following were excluded: 301 (10.9%) due to age, 138 (5.6%) did not receive acute care at a RHSCIR site, and 60 (2.6%) due to penetrating injuries. Application of study criteria revealed eligible participants

(no. from 2004–2013, mean/yr, range) as follows: STASCIS (n = 368 [37, range 27–66]), minocycline (n = 557 [56, range 33–88]), riluzole (n = 303 [30, range 18–47]), sygen (n = 847 [85, range 50–140]), cethrin (n = 301 [30, range 16–60]), NOGO (n = 414 [41, range 19–78]). Of RHSCIR participants with GCS/comorbidity data, 92 of 1148 (8.0%) had a GCS under 13 and 253 of 1441 (17.6%) had one or more serious comorbidities that would exclude participation in most neuroprotective/neuroregenerative trials. **Conclusion:** Our data demonstrates that tSCI clinical trials are feasible within Canada using the RHSCIR multicentre collaboration. However, in practice there are additional challenges recruiting subjects who satisfy the typically tight inclusion criteria, which may impact the completion and generalizability of these studies.

3.3.32

Prospective analysis of adverse events in elderly patients with traumatic spinal cord injury. ***A. Patel,*† J. Batke,* B. Lenehan,* C. Fisher,* M. Dvorak,* J. Street.*** **From *Vancouver General Hospital, Vancouver, BC, and †Middlemore Hospital, Auckland, New Zealand**

Background: The age of traumatic spinal cord injury (TSCI) patients is increasing. Elderly patients have unique pathophysiological characteristics and subsequent co-morbidities. Prospectively collected adverse event data in this cohort has not been published previously, and identification of potential risk factors for these adverse events will help manage these challenging patients. This study updates the demographics of TSCI patients presenting to a level 1 trauma centre from 1995 to present. A prospective analysis of adverse events is performed in a cohort of patients over 65 years with TSCI. **Methods:** Prospective demographic data on all patients admitted with TSCI treated at a single institution between 1995 and 2011 were analyzed. Prospective adverse events data in patients over 65 years with TSCI collected between April 2008 and April 2011 were examined. **Results**: The median age of patients with TSCI has increased from 34.5 in 1995 to 48.5 years in 2011. The primary cause of TSCI has changed from motor vehicle accidents to falls. Of the 94 patients with TSCI in 2011, 18% were over 65 years. In the elderly, the most common mechanism of injury was falls (78%), of which, 68% were less than 1 m in height. A mean of 3 adverse events occurred during each admission. The 3 top adverse events were urinary tract infections (UTIs), pneumonia, and delirium. Length of stay increases were related ($p < 0.05$) to the number of adverse events, pneumonia, systemic infection, UTI, delirium, pressure sores and deep wound infection. Adverse events increase with operative management, and also in a cohort of patients with central cord syndrome that are treated operatively. **Conclusion**: The median age of patients with TSCI is increasing. The elderly have 3 adverse events during an admission. The most common adverse events are UTI, pneumonia, and delirium. There is a significant increase in length of stay with adverse events, and operative management is associated with increased adverse events.

3.3.33

Does traction before surgery influence time to neural decompression in patients with spinal cord injury? ***C. Pinkoski, R. Fox, A. Nataraj.*** **From the University of Alberta, Edmonton, Alta.**

Background: Traction is a commonly used practice to relieve neurologic compression in acute spinal cord injury (SCI). It is unknown whether traction results in a shorter time to decompression compared with urgent surgery without traction. We aimed to investigate this. **Methods:** Records of patients with SCI treated in Edmonton from 2010 to 2013 (Rick Hansen Spinal Cord Injury Research Database) were retrospectively reviewed (American Spinal Injury Association [ASIA] score was prospectively collected). The goal was to determine if there was a significant difference for time to decompression (time from injury to decompression) between traction and surgery. Wilcoxon rank sum testing was used to compare median time to decompression in patient subgroups. **Results:** Of 59 patients with traumatic spinal instability due to fracture or ligamentous injury, 48 had neural compression at the time of initial imaging. Of these, 39 patients had traction and 9 did not. Traction was successful at relieving neurologic compression in 35 of 39 (90%). The median time to decompression in patients who had traction was not significantly different compared with patients who did not (17.7 v. 15.8 h, p = 0.74). Time to decompression was however significantly higher (median 34.8 h) among those with unsuccessful traction compared with patients who had surgery alone for decompression (p = 0.006). **Conclusion:** While the number of patients not undergoing traction in this single centre study was low (reflecting the practice pattern in Edmonton), our initial results suggest that urgent neural decompression can be achieved by either initial traction or by urgent surgery. Because the time to surgical decompression is significantly higher in those undergoing unsuccessful traction, traction as a means of neurologic decompression should be performed only if there is a high likelihood of success. A larger multicentred study investigating predictors of successful traction could help with the decision of whether to attempt traction or not.

3.4.34

Current treatment of individuals with traumatic spinal cord injury: Do we need age-specific guidelines? ***H. Ahn,* C.S. Bailey,† S.D. Christie,‡ N. Duggal,† M.G. Fehlings,§ J. Finkelstein,¶ D.R. Fourney,** R.J. Hurlbert,†† B.K. Kwon,‡‡ A. Townson,‡‡ E.C. Tsai,§§ N. Attabib,¶¶ J. Chen,*** M. Dvorak,***††† V.K. Noonan,‡‡*** C.S. Rivers,*** RHSCIR Network.*** **From *St. Michael's Hospital, University of Toronto Spine Program, Toronto, Ont., †Western University, London, Ont., ‡Dalhousie University, Halifax, NS, §Division of Neurosurgery and Spinal Program, University of Toronto, ¶Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont., **University of Saskatchewan, Saskatoon, Sask., ††University of Calgary Spine Program, Calgary, Alta., ‡‡University of British Columbia, Vancouver, BC, §§The Ottawa Hospital, Ottawa Hospital Research Institute, University of Ottawa, Ottawa, Ont., ¶¶Horizon Health Network/Dalhousie University, St. John, NB, ***Rick Hansen Institute, and †††Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, Vancouver, BC**

Background: The elderly are increasingly at risk for traumatic spinal cord injury (tSCI) from falls compared with younger patients. However, it is unknown if this translates into different

management and outcomes. Our objective was to determine if age affected management decisions and outcomes. **Methods:** tSCI patients with complete records prospectively recruited from 2004 to 2013 for the Rick Hansen Spinal Cord Injury Registry (RHSCIR) were included. Demographic/injury differences between age groups (< 70 yr v. ≥ 70 yr) were assessed. Age (< 70 yr v. ≥ 70 yr), sex, injury etiology (falls v. other), energy of injury (high/low), injury level (cervical v. thoracolumbar), admission ASIA injury score (AIS; A&B v. C&D), and Injury Severity Score (ISS; < 25 v. ≥ 25) were examined with χ^2 bivariate analysis and multivariate analysis for associations with operative treatment. **Results:** Of 1440 participants with operative data, 167 (11.6%) were over 70 years old at time of injury. Older patients were more likely to have been injured by falling compared with higher-energy mechanisms (83.1% v. 37.4%, $p < 0.0001$), to have a cervical injury (75.9% v. 60.1%, $p < 0.0001$), to have admission AIS of C/D (67.9% v. 45.4%, $p < 0.0001$), and a higher number of medical co-morbidities (mean 1.1 v. 0.31, $p < 0.0001$). Older patients were less likely to have received operative treatment (80.2% v. 87.7%, $p = 0.0077$) and to have a high ISS (41.8% v. 60.9%, $p = 0.0011$). Age over 70 years did not affect odds of having operative treatment with multivariate analysis; high energy of injury and AIS of A/B increased the odds of having surgery (2.3 and 5.0, respectively). Older patients had longer time from injury to surgery, and longer acute (but not rehabilitation) length of stay. Age over 70 years was associated with higher in-hospital mortality (25.5% v. 5.6%). **Conclusion:** Practice patterns in Canada demonstrate that age in of itself, does not impact the odds of having surgery. However, older patients wait longer for surgery and have substantially higher in-hospital mortality rates despite less severe injuries. Surgical guidelines for older patients could reverse these trends.

3.4.35

Current surgical practice for traumatic spinal cord injury in Canada. ***B. Drew,[*†] M.G. Fehlings,[‡] J. Paquet,[§] H. Ahn,[¶] N. Attabib,[**††] C.S. Bailey,[‡‡] S.D. Christie,[§§] N. Duggal,[¶¶] J. Finkelstein,[***] D.R. Fourney,[†††] R.J. Hurlbert,[‡‡‡] M.G. Johnson,[§§§] B.K. Kwon,[¶¶¶] S. Parent,[****††††] E.C. Tsai,[‡‡‡‡] M. Dvorak,[§§§§] V.K. Noonan,[¶¶¶¶] C.S. Rivers,[¶¶¶¶] T. Shen,[¶¶¶¶] RHSCIR Network.[¶¶¶¶]*** **From *Hamilton General Hospital, †McMaster University, Hamilton, Ont., ‡Division of Neurosurgery and Spinal Program, University of Toronto, Toronto, Ont., §Hôpital Enfant-Jésus, Laval University, Quebec City, Que., ¶St. Michael's Hospital, University of Toronto Spine Program, Toronto, Ont., **Horizon Health Network/Dalhousie University, ††Saint John Regional Hospital, St. John, NB, ‡‡Western University, London, Ont., §§Dalhousie University, Halifax, NS, ¶¶Division of Neurosurgery, Western University, London, Ont., ***Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ont., †††University of Saskatchewan, Saskatoon, Sask., ‡‡‡University of Calgary Spine Program, Calgary, Alta., §§§University of Manitoba, Department of Surgery, Orthopaedics and Neurosurgery, Winnipeg. Man., ¶¶¶University of British Columbia, Vancouver, BC, ****Hôpital du Sacré-Coeur de Montréal, Hôpital Ste-Justine, ††††Université de Montréal, Montréal, Que., ‡‡‡‡The Ottawa Hospital, Ottawa Hospital Research Institute, University of Ottawa, Ottawa, Ont., §§§§Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, and the ¶¶¶¶Rick Hansen Institute, Vancouver, BC**

Background: Traumatic spinal cord injury (tSCI) is often treated surgically; however, there is no consensus on indications and timing. Published data on rates of surgery for SCI patients vary widely internationally. The objective of this study was to determine surgery rates for tSCI in Canada and describe the demographic and clinical characteristics of operative and nonoperative patients. **Methods:** The tSCI patients with complete records from the Rick Hansen Spinal Cord Injury Registry (RHSCIR), prospectively recruited from 2004 to 2013 from 18 acute care centres across Canada were studied. Data on patient characteristics (e.g., age, ethnicity, neurology) were analyzed using χ^2 tests. **Results:** A total of 1440 participants had complete data; 1250 (86.8%) had surgery. Those with thoracic (T2-T10) injuries were most likely to undergo surgery (94.1%), followed by thoracolumbar (T11-L2; 91.6%), low cervical (C5-T1; 86.8%), and high cervical (C1-C4; 81.1%) injuries ($p < 0.0001$). There was no difference between surgical and nonsurgically treated groups with regards to sex, ethnicity, injury year, time from injury to first neurologic examination, admission Glasgow Coma Scale, or admission Charlson Comorbidity Index. Patients with an ASIA injury score (AIS) A/B at admission were more likely to have surgery than patients with AIS C/D (95.1% v. 80.7%, $p < 0.0001$). Those having surgery were younger (44.6 v. 52.1 y, $p < 0.0001$), were more likely to have been injured by a high energy mechanism (88.9% v. 84.3%, $p = 0.0115$). Participants with one or more comorbidities were less likely to receive surgery (88.8% v 82.2%, $p = 0.0033$). Participants with central cord syndrome were less likely to receive surgery (75.2% v. 92.7%, $p < 0.0001$). Acute length of stay was significantly affected by AIS (A/B 51.5 d v. C/D 26.5 d, $p < 0.0001$) and neurologic level ($p < 0.0001$). **Conclusion:** The surgical rates for both cervical and thoracolumbar injuries are higher than published data. Ongoing analyses will determine if surgical intervention produces superior outcomes and provide evidence to promote the standardization of care.

3.4.36

The importance of "time to surgery" for traumatic spinal cord injured patients: results from an ambispective Canadian cohort of 949 patients. ***M. Dvorak,[*] C. Fisher,[†] B.K. Kwon,[†] B. Drew,[‡§] M.G. Fehlings,[¶] J. Paquet,[**] H. Ahn,[††] N. Attabib,[‡‡§§] C.S. Bailey,[¶¶] S.D. Christie,[***] N. Duggal,[†††] J. Finkelstein,[‡‡‡] D.R. Fourney,[§§§] R.J. Hurlbert,[¶¶¶] M.G. Johnson,[****] J.-M. Mac-Thiong,[††††] S. Parent,[††††‡‡‡‡] E.C. Tsai,[§§§§] N. Fallah,[†¶¶¶¶] V.K. Noonan,[†¶¶¶¶] C.S. Rivers,[¶¶¶¶] RHSCIR Network.*** **From *Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, †University of British Columbia, Vancouver, BC, ‡Hamilton General Hospital, §McMaster University, Hamilton, Ont., ¶Division of Neurosurgery and Spinal Program, University of Toronto, Toronto, Ont., **Hôpital Enfant-Jésus, Laval University, Quebec City, Que., ††St. Michael's Hospital, University of Toronto Spine Program, Toronto, Ont., ‡‡Horizon Health Network/Dalhousie University, §§Saint John Regional Hospital, St. John, NB,**

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Background: The timing of surgery for traumatic spinal cord injury (tSCI) is controversial. Although some recent studies highlight the benefit of surgery within 24 hours of injury, this is not definitive. The objective of this study was to determine current surgical timing for tSCI in Canada and to ascertain whether the timing of surgery influences neurologic outcome in tSCI patients. **Methods:** Ambispective cohort design of tSCI patients who underwent spine surgery within 30 days of injury, and were recruited to the Rick Hansen National Spinal Cord Injury Registry between 2004 and 2013. Patient demographics, admitting and postoperative neurology, timing of surgery were collected. Multiple linear and gamma regression were used to determine correlations between times of arrival at the first acute hospital, initial neurologic examination, and surgery, as well as to determine if there were differential patterns of recovery dependent on time to surgery and admission neurology (ASIA injury scale [AIS] A, B, C or D). Possible reasons for neurologic deterioration over time were also examined. **Results:** A total of 949 patients were included in this analysis. The mean/median/range time to surgery for all participants were 60 h/32 h/2–705 h. Participants with AIS A at admission did not demonstrate an effect of time of surgery on change in motor score; however, surgery within 24 hours on AIS B, C or D increased motor score by almost 7 points. **Conclusion:** In tSCI participants who present with AIS A injuries; the timing of surgery does not appear to influence motor recovery. When the AIS is B, C, and D at admission, surgery within 24 hours from injury is correlated with improved motor score recovery.

3.5.37

Assessment of a novel coil-shaped radiofrequency probe in the porcine spine. ***P. Pezeshki,*† S. Davidson,‡ C. McCann,† M. Akens,‡ K. Murphy,*‡ C. Whyne,*† M. Sherar,*‡ A. Yee.*†* **From the *University of Toronto, †Sunnybrook Health Sciences Centre, and the ‡Techna Institute, University Health Network, Toronto, Ont.**

Background: To evaluate the feasibility and safety of a novel coil-shaped radiofrequency (RF) probe that utilizes both magnetic and electrical fields to create large ablation zones within vertebral bodies. **Methods:** Six healthy Yorkshire pigs (40–50 kg) received a sham and an RF treatment respectively in 2 adjacent cervical levels. A coring drill bit was used to create a cylindrical path into each vertebral body for RF coil probe placement. While the RF coil is designed for minimally invasive deployment in human vertebrae, a surgical approach was required in pigs due to the high bone density of healthy porcine vertebrae. The electronic circuit was completed by 4 grounding pads applied to the dorsal skin of the animal. To monitor thermal rise and for safety, 2 fibre-optic probes recorded temperatures in the centre of each coil and near the spinal foramen. Treatment was delivered at 27 MHz for 10 minutes at 20 W (n = 1), 25 W (n = 1) and 30 W (n = 4). Animals were monitored neurologically postprocedure. Magnetic resonance images (MRIs), taken immediately posttreatment and at 14 days, were segmented to evaluate the ablation volume (AmiraDEV5.2). **Results:** Comprehensive treatment of the porcine vertebrae was demonstrated by the temperature measurements and by post-treatment MRI. Large zones of ablation (treatment damage volume of 5.7 ± 1.4 cm^3 v. sham damage volume, caused by drilling, of 2.4 ± 0.2 cm^3) were confined within the vertebral body. Maximum recorded temperatures in the treated levels ranged from 66.1°C to 102.9°C, with no significant temperature rise outside of the vertebrae (38.2°C ± 1.5°C). Ablation effects on MRIs were best visualized at day 14. Mobility, neurologic responses and behaviour post-procedure and at 2 weeks were normal and consistent with pre-procedural examination. Fibrous-appearing tissue was seen during gross dissection at the drilling site in 11 of the 12 excised vertebrae. **Conclusion:** We demonstrated the ability of a bone-specific RF coil probe to create large ablation volumes with no neurologic sequelae. The novel RF coil probe offers the potential for a safe and minimally invasive treatment for spinal metastases.

3.5.38

The effect of norepinephrine and dopamine on cerebrospinal fluid pressure after acute spinal cord injury. ***F. Altaf, L. Belanger, J. Ronco, N. Dea, S. Paquette, M. Boyd, J. Street, C. Fisher, M. Dvorak, B. Kwon.* From Vancouver General Hospital, Vancouver, BC**

Background: Vasopressors are commonly used to augment mean arterial pressure (MAP) after acute spinal cord injury (SCI). While many vasopressors with different pharmacologic activities are available, there are no formal recommendations for the acute SCI setting. Furthermore, their effects on intrathecal pressure (ITP) have not been previously evaluated, even though spinal cord perfusion pressure is the difference between the MAP and ITP. **Methods:** In this study, we evaluated the effects of 2 vasopressors on MAP and ITP in acute SCI patients: norepinephrine (NE) and dopamine (DA). Intrathecal pressure was continuously measured using a lumbar intrathecal catheter residing caudal to the injury site. The patients underwent a "crossover" in which they were switched from NE to DA, or vice versa, while keeping the MAP constant. **Results:** Ten patients with acute SCI (either AIS A or B) were evaluated. There were 2 vasopressor crossover interventions in which patients on dopamine and norepinephrine were switched to purely norepinephrine. There were 20 interventions in which patients receiving norepinephrine were changed to dopamine. There was 1 intervention where the patient on dopamine was crossed to be on norepinephrine. One intervention switched a patient on dopamine and norepinephrine to be on dopamine only. **Conclusion:** There was an average increase in ITP of 3.37 (range 0.27–8.6) when there was a crossover from norepinephrine to dopamine. This suggests that the choice of vasopressor can affect the intrathecal pressure which is an important parameter post spinal cord injury. We have found that both norepinephrine and

dopamine are able to achieve MAPs above 80 mm Hg but norepinephrine is able to achieve this at a lower intrathecal pressure.

3.5.39

The learning curve of pedicle screw placement: How many screws are enough? ***P. Wilde, A. Gonzalvo, G. Fitt, S. Liew, D. de la Harpe, P. Turner, M. Rogers.*** **From Austin Hospital, Melbourne Victoria, Australia**

Background: To assess the learning curve for pedicle screw (PS) placement of a spinal surgery fellow (SSF) who has no previous experience with the technique. **Methods:** All patients who had PS inserted by the SSF under the supervision of an attending spinal consultant (ASC) and had adequate postoperative radiographs and computed tomography scans available, were included in this study. The PS position was assessed by 2 blinded independent observers using a grading scale. Pedicle screw placement by the SSF was evaluated by examining the assessed position in chronological groups of 40 screws. **Results:** Ninety-four patients underwent internal fixation of the spine with 582 PS. Eight cases (40 screws) were excluded because of lack of imaging studies. Of the 542 screws under evaluation, 320 (59%) were performed by the SSF, 187 (34.5%) by the ASC, and 35 (6.5%) by advanced orthopedic or neurosurgical trainees. The rate of misplaced PS performed by the SSF for the first 80 PS was 12.5%, which dropped to 3.4% for the remaining 240 screws ($p < 0.01$). Evaluation of computed tomography of vertebrae with PS placed by the SSF on one side and by the ASC on the other showed that the ASC achieved better placement during the first 80 PS ($p < 0.01$). However, this difference disappeared in the last 240 ($p = 1.00$). **Conclusion:** The findings demonstrate a learning curve for PS placement. In this series, the asymptote for this technique for an inexperienced SSF, started after about 80 screws (approximately 25 cases).

Saturday, February 28, 2014

4.1.40

Preliminary report from the Ontario Inter-professional Spine Assessment and Education Clinics (ISAEC). ***Y.R. Rampersaud,[*†] A. Bidos,[‡††] C. Fanti,[§††] B. Young,[††] B. Drew,[**††] D. Puskas.[¶††]*** **From the *Division of Orthopaedic Surgery and Neurosurgery, Department of Surgery, University of Toronto, †Arthritis Program, Toronto Western Hospital, University Health Network, University of Toronto, ‡Allied Health, Toronto Western Hospital, University Health Network, Toronto, Ont., §Rehabilitation, Thunder Bay Regional Health Sciences Centre, ¶Division of Orthopaedics, Thunder Bay Regional Health Sciences Centre, Northern Ontario School of Medicine, Thunder Bay, Ont., **Division of Orthopaedics, Hamilton General Hospital, McMaster University, Hamilton, Ont., and ††Inter-professional Spine Assessment and Education Clinics, University Health Network, Toronto, Ont.**

Background: The Ontario Ministry of Health is piloting a shared-care model of care for the management of low back pain (LBP). Using an integrated "hub and spoke" design, the Inter-professional Spine Assessment and Education Clinics (ISAEC) utilizes advanced practice clinicians to enable a networked link between the patients' primary care providers and specialists providing multidisciplinary team based care that is stratified to patient risk and needs (i.e., right care, right time, right provider). The objective of this preliminary study was to report on patient stratification and satisfaction as well as change in primary care provider (PCP) confidence in managing LBP. **Methods:** Prospective clinical (validated intake screening questionnaires), quality and process data from 606 ISAEC initial patients seen between November 2012 and June 2013 were reviewed and summarized. **Results:** The mean wait for primary assessment was 6.9 days. The majority of patients (67%) were diagnosed with back-dominant pain (aggravated by flexion in 39% and by extension in 28%). Risk of chronicity was found to be moderate/high in a majority of patients (62%); inflammatory LBP risk was moderate/high in 7% of patients and opioid abuse risk was moderate/high in 17%. Twenty-eight percent were deemed possible surgical candidates and referred for secondary assessment by networked spine surgeons. Surgical assessment data from one site demonstrated a 6.9 week wait time and a referral appropriateness of 96%. Overall patient satisfaction ($n = 520$) was 98% and 93% felt they understood their condition better. When asked if they would have preferred to see a spine surgeon/specialist directly, 94% said no. At 4 months into the pilot, enrolled PCPs showed a 2-fold increase in their confidence managing LBP (assessment and management, referral for imaging and specialist consultation). **Conclusion:** A shared-care model of care provides significant improvements in the assessment and management across the continuum of care for LBP.

4.1.41

A surrogate model of the spinal cord complex for simulating bony impingement. ***C. Sparrey, H. Tam, S. Manansala, V. Nosov, M.L. Delva.*** **From Simon Fraser University, Surrey, BC**

Background: The primary objective of this research is to develop an accurate physical surrogate of the spinal cord and surrounding membranes that captures the in vivo mechanical behaviour of the spinal cord. This surrogate cord system is needed to characterize loading in the spinal cord resulting from bony impingement due to spine degeneration or traumatic impact. Currently, mechanical characterization of spinal implants uses in vitro mechanical tests on cadaveric spine segments. There is no spinal cord in these segments due to rapid post mortem degradation. **Methods:** Silicone based polymers were selected for the spinal cord and dura based on published material properties for human and animal tissues. Spinal cord components were cast in rapid prototyped moulds from an magnetic resonance image of a human cervical spinal cord. The mechanical response of the spinal cord and dura were verified by tensile and compressive testing. The spinal cord construct was connected to a water column to pressurize the cerebrospinal fluid (CSF) and a high rate impact was delivered. Force-deformation of the spinal cord was compared with published animal models of impact. **Results:** The surrogate spinal cord and dura properties compared well with published animal and human tissue data. The spinal cord behaved nearly linearly in tension to 10% strain. The modulus of the spinal cord was 0.2 MPa. The cord was nonlinear in compression.

Stiffness increased significantly beyond 15% strain. The dura mater response to tensile loading was linear below 20% strain. The Young's modulus for the dura was 2.93 MPa ± 0.27 MPa for low strains (< 20). Characterization of the whole cord complex is ongoing. **Conclusion:** We have constructed a physical surrogate of the spinal cord, dura, CSF assembly that accurately mimics the spinal cord and dura. This system will provide a new tool to measure spinal cord loading resulting from impingement of degenerated spinal columns or traumatic injury.

4.1.42

Clinical and surgical predictors of specific complications following surgery for the treatment of degenerative cervical myelopathy: results from the multicentre, prospective AOSpine international study on 479 patients. ***L. Tetreault,*[*] N. Alshafai,[†] B. Kopjar,[‡] G. Tan,[†] P. Arnold,[§] M. Fehlings.*[*†]*** **From the *University of Toronto, †Toronto Western Hostital, Toronto, Ont., ‡University of Washington, Seattle, Wash., and the §University of Kansas Medical Center, Kansas City, Kans.**

Background: The objective of this study was to characterize and quantify perioperative complications in patients undergoing surgery for the treatment of degenerative cervical myelopathy. Furthermore, this study was designed to identify important clinical and surgical predictors of specific complication categories. **Methods:** Over a 3-year period, 479 patients diagnosed with degenerative cervical myelopathy and treated surgically were enrolled in the Cervical Spondylotic Myelopathy (CSM)-International Multicentre Study at 16 global sites. The overall incidence of perioperative complications was quantified along with the rate of occurrence of 6 predefined complication categories: 1) systemic, 2) neurologic, 3) surgical, 4) pain, 5) dysphagia and 6) infection. Univariate analyses were performed to determine demographic and surgical differences between patients who suffered a specific complication postsurgically and those who did not. A multivariate logistic model was subsequently created to determine the impact of each factor on complication development. **Results:** Eighty-two patients experienced 102 perioperative complications, yielding an incidence of 17.8%. Patients with complications were on average older (57.67 ± 11.25) and had a higher body mass index (27.41 ± 30.42) compared with those without complications (56.03 ± 12.10, 25.63 ± 4.56), although these relationships did not reach significance. The major risk factor for complication development was the number of comorbidities preoperatively (1.23 ± 1.12 v. 0.93 ± 1.10, $p = 0.013$) and the presence of endocrine ($p = 0.014$) and cardiovascular disorders ($p = 0.084$). There was no difference in the rate of complications between anterior or posterior approaches. Patients undergoing a 2-stage circumferential approach, however, were at a greater risk of experiencing perioperative complications compared with patients treated with either an anterior or posterior surgery. Finally, patients with complications had on average a longer operative duration (206.6 ± 91.36) than those without complications (172.5 ± 76.89) ($p = 0.014$). **Conclusion:** This study identifies a list of key predictors of complication development following surgery for the treatment of degenerative cervical myelopathy. This model will help clinicians identify high risk patients, allowing them to institute a rigorous complication prevention plan.

4.2.43

Outcomes of surgical management of cervical spondylotic myelopathy: results of the prospective, multicentre, AOSpine international study in 479 patients. ***M. Fehlings,*[*] B. Kopjar,[†] P. Arnold,[‡] A. Ibrahim,*[*] L. Tetrault.*[*]*** **From the *University of Toronto, Toronto, Ont., †University of Washington, Seattle, Wash., and the ‡University of Kansas, Kansas City, Kans.**

Background: The efficacy of surgical decompression for cervical spondylotic myelopathy (CSM) has been recently reported for the North American population in prospective multicentre study. However, data are lacking regarding international variations in patient presentation, management and outcomes for CSM. Here, we present results of a prospective, international multicentre study of the management of CSM. **Methods:** Between 2007 and 2011, 479 patients with CSM were prospectively enrolled in 16 sites based in Asia Pacific (AP; $n = 150$), Europe (E; $n = 126$), Latin America (LA; $n = 80$) and North America (NA; $n = 123$). Demographic information, surgical technique and functional outcome parameters including Modified Japanese Orthopaedic Association (mJOA), Nurick Score, neck disability index (NDI), SF36v2 were collected. **Results:** The mean age at presentation was 56.4 years (± 11.91) and 65% were males. There were no significant regional differences in baseline mJOA, Nurick and NDI scores ($p < 0.1$) but LA patients had a significantly lower SF-36 Physical Component Summary (PCS) and a much higher SF-36 Mental Component Summary (MCS) ($p < 0.008$). Across the regions there were significant differences in presenting age ($p < 0.0003$) and etiology ($p < 0.001$). There were regional differences in surgical approach: in E (71.43%), AP (61.07%) and NA (56%) underwent anterior surgery whereas in LA most (66.25%) had posterior surgery. Overall, most patients had anterior surgery (57.7%). All outcome measures (mJOA, Nurick, NDI and SF36v2) showed significant improvement ($p < 0.001$) at 1 year. mJOA improved from 12.48 to 14.9, NDI improved from 37.33 to 25.24 and Nurick score improved from 3.28 to 2.00. Both SF-36v2 PCS and SF-36v2 MCS also improved from 34.23 to 41.18 and from 39.52 to 46.22, respectively. There were regional differences in outcome with patients from AP and NA showing greater functional improvement in mJOA and Nurick than patients from Europe. **Conclusion:** In a large international study we have shown that surgical decompression for patients with CSM was beneficial despite the differences in presentation and surgical techniques.

4.2.44

A clinical prediction rule for clinical outcomes in patients undergoing surgery for degenerative cervical myelopathy: analysis of an international AOSpine prospective multicentre data set of 757 subjects. ***L. Tetreault,*[*] B. Kopjar,[§] P. Arnold,[‡] M. Fehlings.*[*†]*** **From *University of Toronto, †Toronto Western Hostital, Toronto, Ont., ‡University of Kansas Medical Center, Kansas City, Kans., and the §University of Washington, Seattle, Wash.**

Background: It is often difficult to predict clinical outcomes in patients with degenerative cervical myelopathy (CSM) due to the heterogeneity of this population. The objective of this study is to develop a clinical prediction rule relating the best combination of

clinical and imaging variables to surgical outcome, based on international data from 2 multicentre prospective studies. **Methods:** Two hundred and seventy-eight patients diagnosed with CSM were enrolled in the CSM-North American study at 12 different sites. An additional 479 patients participated in the CSM-International study from 16 global sites in 4 continents. Univariate analyses were performed to evaluate the relationship between outcome, assessed by a Modified Japanese Orthopaedic Association (mJOA) score, and various clinical and imaging predictors. Multivariate logistic regression was used to formulate the final model and identify factors that could predict a "successful outcome" (mJOA ≥ 16). **Results:** Univariate analyses demonstrated that the odds of a successful outcome decreased with the presence of certain symptoms, including clumsy hands (OR 1.85, p = 0.0013), impaired gait (OR 4.26, $p < 0.001$), bilateral arm paresthesia (OR 1.54, p = 0.0066) and limb weakness (OR 2.56, $p <$ 0.0001); the presence of certain signs, including corticospinal distribution motor deficits (OR 2.36, $p < 0.0001$), hyperreflexia (OR 1.53, p = 0.024), upgoing plantar responses (OR 1.83, p = 0.0006) and lower limb spasticity (OR 1.96, $p < 0.0001$); smoking (OR 0.66, p = 0.023); the presence of cardiovascular comorbidities (OR 0.50, $p < 0.0001$); a lower baseline mJOA (OR 1.36, $p < 0.0001$); and older age (OR 0.96, $p < 0.0001$). The final clinical prediction rule included age (OR 0.97, $p < 0.0001$, duration of symptoms (OR 0.88, p = 0.045), smoking status (OR 0.53, p = 0.0022), impairment of gait (OR 2.17, p = 0.0018), corticospinal distribution motor deficits (OR 1.55, p = 0.029), depression or bipolar disorder (OR 0.68, p = 0.12) and baseline severity score (OR 1.26, $p < 0.0001$). The area under the receiver operator curve was 0.76, indicating good model prediction. **Conclusion:** We have developed a clinical prediction rule to predict surgical outcome in CSM patients from across the world. The results from this study should encourage surgeons to operate earlier and on patients with milder myelopathy, to recommend cessation of smoking before surgery, and to control a patient's psychiatric disorders preoperatively.

4.2.45

The prevalence and impact of low back and leg pain among aging Canadians: a cross-sectional survey. ***R. Rampersaud,*†* ***K. Sundararajan,†*** ***S. Eng.‡*** **From the *Division of Orthopaedic Surgery and Neurosurgery, Department of Surgery, University of Toronto, †Arthritis Program, Toronto Western Hospital, University Health Network, and ‡CARP Canada, Toronto, Ont.**

Background: The objectives of this study were: 1) to characterize the prevalence of low back and leg pain in the aging population; 2) to determine the self-reported impact of lumbar symptoms on quality of life (QoL); and 3) to assess the attitudes of these individuals toward surgical management. **Methods:** A voluntary, cross-sectional online survey regarding lumbar symptoms, symptom severity and treatment considerations was made available to members of Canadian Association of Retired Persons in 2012. **Results:** Out of 3757 total responses, 2781 complete questionnaires were analyzed. Most respondents were men (59%) and were from Ontario (59%). From the entire sample, over half of all respondents (60%) reported some level of lumbar spinal symptoms: back pain only (23%); leg pain only (9%); both back and leg (likely lumbar spinal stenosis [LSS] –28%). Seventy-two percent of those with spine symptoms saw a physician. Spinal symptoms affected their quality of life "quite a bit" or "a great deal" in 38% of those with both back and leg symptoms and 11% in those with back pain only. About a quarter of respondents with leg and back symptoms (24.4%) reported that they had been diagnosed with a "pinched nerve" (i.e., probable LSS). Of respondents who were diagnosed with a "pinched nerve," the majority (56.4%) reported that they were told that "nothing could be done" for treatment, and 74.8% reported that they would not consider surgery. **Conclusion:** Back and leg symptoms are highly prevalent with a significant impact on the quality of life in the aging population. Approximately half of symptomatic individuals may be suffering from LSS, but the majority are unaware of or unwilling to consider the value of surgery for their symptoms. It is likely that LSS in being undertreated in the aging population; however, this assertion requires further investigation.

4.3.46

Adjacent segment pathology: Progressive disease course or a product of iatrogenic fusion? ***A. Jack, G.H. St-Pierre, A. Nataraj.*** **From the University of Alberta, Edmonton, Alta.**

Background: Published literature reports a 3% annual incidence and 26% 10-year prevalence of cervical spine clinical adjacent segment pathology (CASP). Controversy exists surrounding the pathophysiology, whether it is due to the mechanical stress of a fusion segment on adjacent levels or due to patient propensity to develop progressive degenerative change. We aim to investigate this relationship by comparing prevalence of CASP in traumatic and spondylotic patient cohorts. **Methods:** In this retrospective cohort study, we reviewed all cervical spine fusion cases for trauma in Edmonton from 2002 to 2008. We compared the prevalence (as of 2013) of adjacent segment surgery for CASP in this group to that in patients having elective single level cervical fusion for degenerative disease. **Results:** There was a higher proportion of females (51 of 100 v. 8 of 41, p = 0.0006, Fisher exact test) and anterior only surgery in the degenerative group (99 of 100 v. 27 of 41, $p < 0.0001$, Fisher exact test). Mean age between groups was not significantly different (49 yr in the trauma cohort, 52 yr in the degenerative cohort, $p > 0.05$, t test), nor were mean follow-up times (6 yr in the trauma group and 6 yr in the degenerative group, $p > 0.05$, t test). There was a significantly higher reoperation rate for CASP in the degenerative group compared with the trauma group (10 of 100 v. 0 of 41, p = 0.035, Fisher exact test). **Conclusion:** In this, the only cohort study of which we are aware comparing surgery for adjacent level pathology in patients with trauma compared with those with degenerative disease, we found a higher rate of repeat surgery in patients with degenerative disease. This finding suggests that the cause of CASP is patient factors predisposing to progressive degenerative disease and not mechanical factors. We also found that the rate of CASP in our patients with degenerative disease was lower than in other published reports.

4.3.47

Natural history of degenerative lumbar spondylolisthesis in patients with spinal stenosis. ***R. Johnstone, J. Urquhart, P. Rosas-Arellano, C. Tallon, K.R. Gurr, F. Siddiqi, S.I. Bailey, C.S. Bailey.*** **From Western University, London, Ont.**

Background: To determine the rate of progression of lumbar degenerative spondylolisthesis (LDS) in a cohort of patients followed prospectively for spinal stenosis. Also, to determine if slip progression correlates with patient health-rated quality of life (HRQoL) outcomes assessed. **Methods:** A consecutive series of patients with LDS not requiring operative treatment were enrolled in this prospective study between 2006 and 2010. Lateral lumbar radiographs and HRQoL measures, including SF-36, Oswestry Disability Index, and numeric rating scale (1–10) for back pain and leg pain, were collected at the initial consult and annually thereafter. Radiographic measures included: slip percentage, slip progression, and mean disc height. Progression of LDS was defined by an over 5% increase in slip percentage. Interrater variability of radiographic parameters was assessed by intraclass correlation coefficient (ICC). Baseline characteristics and radiographic parameters were compared between patients that had slip progression and those that did not using a Student t test or χ^2 test. Main effects of time and slip progression were assessed using 2-way repeated-measures analysis of variance. **Results:** Eighty-one patients were followed for an average of 3.7 ± 1.2 years. Eighty-four levels were analyzed (3 patients had 2 levels of LDS). The reliability of radiographic measurements was high (ICC 0.92). Fifteen patients (19%) demonstrated slip progression. At baseline, the cohort without slip progression had a larger percentage slip (21.2% ± 7%) compared with the cohort that did demonstrate slip progression (16.5% ± 6.4%; $p < 0.01$). Otherwise baseline characteristics were not different. The change in percentage slip was 8.0% (± 2.1%) in the cohort that progressed and 0.0% (± 3.2%) in the group that did not ($p < 0.001$). The change in disc height was similar between groups. All average outcome measures were similar between groups ($p > 0.05$). **Conclusion:** A total of 19% of patients demonstrated progression of LDS. Progression does not correlate with HRQoL measures.

4.3.48

Changes in self-reported clinical status and health care utilization during wait time for surgical spine consultation: a prospective observational study. ***A. Fernandes,* K. Sundararajan,* R. Rampersaud.*†*** **From the *Arthritis Program, Toronto Western Hospital, University Health Network, and the †Division of Orthopaedic Surgery and Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ont.**

Background: The objective of this study was to assess changes in self-reported clinical status and health care utilization while waiting for surgical spine consultation. **Methods:** At the time of elective referral to an academic surgical spine practice, study questionnaires were mailed to 1105 low back patients who, based on the referral information provided, were possible surgical candidates (i.e., triaged referrals). The referral questionnaire was returned by 47% (524 patients), and 313 patients completed the referral and consultation questionnaires. The primary outcomes were the SF-36 bodily pain (BP) and physical functioning (PF) subscores and self-reported health care utilization. Analysis was stratified to 3 groups: patients deemed appropriate surgical candidates (surgical candidate: $n = 134$, and surgical: $n = 100$) or nonsurgical ($n = 73$). Groups were compared using t test, analysis of variance (ANOVA), and χ^2 analysis. **Results:** Mean consultation wait time was 6.1 (1–18) months. Wait time was not significantly different between groups. Diagnostically, patients in the nonsurgical, surgical and surgical candidate groups presented with stenosis (12%, 27%, 17%), disc herniation (23%, 22%, 34%), spondylolisthesis (8%, 46%, 38%) and degenerative disc disease (41%, 1%, 3%). The change in BP was significantly different among the nonsurgical, surgical and surgical candidate groups, with the surgical group significantly worsening during the wait time (1.9, –9.2 and 5.7 points, respectively; $p < 0.001$). Change in PF was not significantly different between groups ($p = 0.29$). Patients in the surgical group were more likely ($p < 0.001$) than others to feel that their symptoms had worsened (57% v. 33% of the surgical candidate groups and 44% of the nonsurgical groups). There were no significant differences between groups in the utilization of any provincially insured spine-related health care, or allied health services ($p > 0.3$). **Conclusion:** For patients electing to proceed with surgical intervention, bodily pain tends to significantly worsen during a relatively short wait (mean 6 months) for consultation. These results support the need for a significant reduction of surgical consultation times for spinal disorders.

4.3.49

The Canadian surgical wait list for lumbar degenerative spinal stenosis has a detrimental effect on patient outcomes. ***J. Urquhart,* P. Rosa-Arellano,* C. Tallon,* S. Bailey,*† K. Gurr,*† C. Bailey.*†*** **From the *London Health Sciences Centre, and the †University of Western Ontario, London, Ont.**

Background: To determine the effect of surgical wait time (SWT) for lumbar degenerative spinal stenosis surgery on patient rated outcomes (HRQoL). **Methods:** A total of 166 consecutive patients treated surgically at a tertiary spine centre for lumbar spinal stenosis (LSS) were prospectively enrolled from 2006 to 2011. The SF-36-Physical Component Score (PCS), SF-36-Mental Component Score (MCS), Oswestry Disability Index (ODI), and numeric rating scale (1–10) for back (BP) and leg pain (LP) were completed at: surgical referral; initial surgical consult; preoperatively; and 1.5, 3, 6, 12 and 24 months postoperatively. The SWT was the time between referral to surgery. Characteristics of patients with a shorter SWT than the median were compared with those that had longer SWT. One-way repeated-measures analysis of variance (ANOVA) compared preoperative with postoperative HRQoL. Multivariate logistic regression determined the effect of SWT on HRQoL adjusting for surgeon, age, sex, body mass index, prereferral symptom duration, and surgery type. The clinically important deterioration (CIDET) defined symptom worsening. The minimum clinically important difference (MCID) defined symptom improvement. **Results:** The average age was 66.2 (± 9.0) years. Two-year follow-up was completed by 85%. The median SWT was 12 months (range 2–31). Patients who waited under 12 months had a worse baseline SF-36-MCS, ODI, LP, and a shorter symptom duration at surgical consult than patients with a SWT over 12 months. Yet, patients were more likely to experience a CIDET in physical function (SF-36-PCS) with increasing surgical wait time ($p = 0.04$). Surgery improved average HRQoL for all outcome measures ($p < 0.001$). However, a prolonged SWT was associated with a lower likelihood of reaching MCID for LP intensity at 3, 6, 12 and 24 months ($p \leq 0.03$), LP frequency at 3 and 6 months ($p \leq 0.01$) and ODI at 1.5

and 6 months ($p \leq 0.03$). **Conclusion:** This study demonstrates that although patients with worse HRQoL at surgical consult had a shorter SWT, a prolonged SWT was detrimental to preoperative physical function, as well as postoperative pain and function.

4.3.50

Segmental lordosis is independent of interbody cage position in XLIF. ***A. Morokoff,*** [*] ***R. Parker,*** [†] ***L. Milili,*** [‡] ***B. Goss,*** [‡] ***G. Malham.*** [†] **From *Parkville Neurosurgery, †Epworth Hospital Neuroscience Institute, and ‡Nuvasive Australia, Melbourne, Australia**

Background: It is believed that anterior cage placement in lateral interbody fusion results in the greatest gains in postoperative segmental lordosis. In contrast, maximum foraminal decompression through restoration of posterior disc height is achieved by positioning the cage in the posterior region of the disc. This study aims to establish the effect of anterior-posterior cage position and end plate distraction on segmental lordosis. **Methods:** Pre- and postoperative radiographs following lateral interbody fusion performed by 2 independent surgeons were analyzed. Measurements of segmental lordosis, A-P cage position (classified into quartiles) and end plate distraction were made from computed tomography (CT) images using electronic imaging measurement tools. Sixty-four levels were fitted with 8 mm height cages and 16 were fitted with 10 mm height cages. All cages had 10° of in-built lordosis. **Results:** Cage positioning in the most posterior quartile achieved the greatest postoperative disc height ($p = 0.017$) and change in disc height ($p < 0.001$) compared with other quartiles. Taller cages provided significantly more segmental lordosis (11.89°) than shorter cages (7.92°) when placed posteriorly ($p = 0.025$). For a given cage height, however, segmental lordosis was independent of anterior or posterior positioning. **Conclusion:** These results suggest that segmental lordosis is increased by using taller cages, regardless of anterior or posterior placement. The degree of lordosis achieved likely represents a complex interplay between the anterior (ALL) and posterior (facet joints, interspinous) tension bands and the amount of pivot around the cage. The in-built lordosis in the cage appears to be unrelated to the amount of segmental lordosis achieved.

4.3.51

Elevated patient BMI does not negatively affect self-reported outcomes of thoracolumbar surgery. ***N.A. Manson,*** [*†] ***A.J. Green,*** [*] ***M. McKeon,*** [*] ***E.P. Abraham.*** [*†] **From *Saint John Regional Hospital, and †Dalhousie Medicine, Saint John, NB**

Background: Clinically, the relationship between body mass index (BMI) and spinal surgery outcomes might seem obvious. However, the literature on this topic is inconclusive. A deeper understanding of this relationship could help inform surgical decisions and increase success. The purpose of this study was to examine differences in outcomes between normal weight and obese patients following thoracolumbar surgery. **Methods:** A prospective patient outcomes database identified 272 consecutive adult patients with minimum 1-year follow-up. Participants were categorized by BMI: normal (BMI < 30, $n = 149$), preobese (BMI 30–35, $n = 59$), and obese (BMI > 35, $n = 64$). Three categories were measured: 1) outcomes: SF-36 Physical Component Summary (PCS), mental component summary (MCS), back and leg pain numeric rating scale (NRS-Back and -Leg), and Oswestry Disability Index (ODI), satisfaction; 2) surgical: blood loss, surgery duration; 3) complications: adverse events, readmissions, reoperations. Multivariate analysis of covariance (MANCOVAs) models assessed the relationship between BMI and each of the outcome categories while controlling for age, physician, gender, levels, surgical approach, and type of surgery. If this showed a group main effect, ANCOVA with Sidak adjustment was used. **Results:** These analyses identified group differences in PCS and NRS-Back difference scores ($p = 0.009$; $p = 0.010$). Post hoc analyses revealed some unexpected results. While all group means met minimum clinically important differences, obese and preobese patients reported significantly greater relief of back pain than Normal weight patients ($p = 0.046$; $p = 0.039$). Furthermore, obese patients showed significantly greater improvement in physical functioning than normal weight patients ($p = 0.009$). **Conclusion:** Patients with elevated BMI may receive greater benefit following spine surgery than normal weight patients. Therefore, elevated BMI alone may not be an appropriate exclusion criterion for spine surgery. Future research should address surgical techniques best suited for obese patients and identify an upper limit of BMI above which surgery may be contraindicated.

Poster presentations

1.5.52

The Spinal Stenosis Pedometer and Nutrition Lifestyle Intervention (SSPANLI): development and pilot. ***C. Tomkins-Lane,* L. Lafave,* J. Parnell,* J. Rempel,* S. Moriartey,§ Y. Andreas,* P. Wilson,‡ C. Hepler,* H. Ray,* R. Hu.†*** **From *Mount Royal University, †University of Calgary, Calgary, Alta., ‡Brock University, St. Catharines, Ont., and §Alberta Health Services, Calgary, Alta.**

Background: Owing to mobility limitations, people with lumbar spinal stenosis (LSS) are at risk for diseases of inactivity, including obesity. Therefore, weight management in LSS is critical. Body mass index is the strongest predictor of function in LSS, suggesting that weight loss may promote physical activity and provide a unique treatment option. We propose a lifestyle modification approach of physical activity and nutrition education, delivered through an e-health platform. The objective of this study was to develop and pilot an e-health intervention aimed at increasing physical activity and decreasing fat mass in people with LSS. **Methods:** The e-health platform was developed. We recruited 10 overweight or obese individuals with LSS. Baseline and follow-up testing included dual energy X-ray absorptiometry, blood draw, 3-day food record, 7-day accelerometry, questionnaire, and walking test. Intervention: During week 1, participants received a pedometer, a personalized consultation with a dietician, and an exercise physiologist. For 12 weeks participants logged on to the website to access personal step goals, walking maps, nutrition videos, and a discussion board. Follow-up, including structured interviews, occurred at week 13. **Results:** Nine participants had a mean age of 67.5 ± 6.7 years (60% female). Significant improvements were observed for fat mass (DXA), trunk fat mass, symptom severity (Swiss Symptom Scale), energy intake, maximum continuous activity (accelerometry), and mental health (SF-36) ($p < 0.05$). Nonsignificant improvements were observed for waist circumference, pain, Oswestry Disability Index, and obesity biomarkers. Seventy percent lost weight, 50% increased walking capacity and 60% increased quality of life. The mean increase in steps was 15%. **Conclusion:** The SSPANLI intervention was shown to be feasible, attractive to participants, and effective in this small sample. This intervention provides people with LSS the opportunity to participate in their own health management, potentially improving access to care. Efficacy is currently being assessed in a randomized trial.

1.5.53

Study evaluating the variability of surgical strategy planning for patients with adult spinal deformity. ***P. Phan,*† A. Ploumis,* K. Hess,* K. Wood.**** **From *Harvard University, Boston, Mass., and the †University of Ottawa, Ottawa, Ont.**

Background: Literature guiding the management of adult spinal deformity (ASD) consists primarily of studies with low level of evidence. Therefore there is a lack of consensus and guideline in the clinical practice and treatment of ASD. The objective of this paper is to evaluate the variability in surgical strategy planning of ASD based on patient clinical and radiographic data. **Methods:** Twenty-eight adult deformity surgeons (members of International Spine Study Group, Canadian Spine Society and Chinese Spine Society) were asked to complete an online survey of 10 spinal deformity cases. Case presentation included a clinical vignette with photographs, Oswestry Disability Index and visual analogue scale scores and imaging with 3 foot anteroposterior spinal radiograph with radiographic measurements. For each case, the surgeons were asked whether surgical management would be beneficial and their surgical plan (approach, staging, need for fusion, osteotomy or decompression and the techniques used). Four surgeons were asked to re-evaluate all 10 cases over a month after their first evaluation. Intraobserver and interobserver reliability were studied using average Cohen and Feiss κ statistics, respectively. **Results:** Average intrarater and interrater agreement for surgical strategy were evaluated to be substantial (κ = 0.62) and fair (κ = 0.24), respectively. Detailed interrater statistics demonstrates that there was only slight agreement on the need for surgery (κ = 0.15), the approach (κ = 0.15), and the need for fusion (κ = 0.16) while moderate agreement was reached for the need for decompression (κ = 0.42) and osteotomy (κ = 0.29). The highest recommendation among surgeons (84.14%) about the beneficial effect of surgery was found for severe deformities and deformities with neurology for which osteotomies and decompression were respectively consistently recommended. **Conclusion:** Agreement about the need for surgery and the surgical strategy is limited between surgeons. Yet each surgeon seems consistent in approaching and treating ASD. This might be due to the fact that ASD remains an area with limited surgical treatment guidelines and literature and where treatment is more likely influenced by personal experience. Findings from this survey highlight the need for comprehensive classifications for ASD, higher-level studies including randomized trials in order to set guidelines and lessen the variability in clinical practices.

1.5.54

Atlantoaxial instability in acute odontoid fractures is associated with nonunion and mortality. ***N. Evaniew, B. Yarascavitch, K. Madden, M. Ghert, B. Drew, M. Bhandari, D. Kwok.*** **From McMaster University, Hamilton, Ont.**

Background: Odontoid fractures are the most common geriatric cervical spine fractures. Nonunion rates vary up to 40%, mortality varies up to 35%, and poor functional outcomes are common. Atlantoaxial instability (AAI) is a plausible prognostic factor, but its role has been underevaluated. The objective of this retrospective cohort study was to determine the effect of AAI on the outcomes of nonunion and mortality in patients with acute odontoid fractures. **Methods:** A total of 124 consecutive patients with acute odontoid fractures were identified. Two independent blinded reviewers measured AAI using presenting computed tomography scans. Patients were classified as having "severe" or "minimal" AAI on the basis of greater versus less than or equal to 50% mean subluxation across each C1-C2 facet joint. Rates of nonunion and mortality were compared using independent sample *t* tests. The results were adjusted for age, fracture displacement, and subtype using multivariate binary logistic regression. **Results:** A total of 107 patients had minimal AAI, and 17 had severe AAI. Mean follow-up was 4.37 months. Patients with

severe AAI were more likely to experience nonunion (29% v. 10%, respectively; $p = 0.03$) and mortality (35% v. 14%, respectively; $p = 0.03$) regardless of treatment modality. Fracture displacement correlated with AAI ($r^2 = 0.649$). When adjusted for patient age, the odds ratio (OR) of nonunion with severe AAI approached significance at 3.3 (95% CI 0.9–11.7). Mortality prediction with AAI approached a 2-fold increased risk (OR 2.1; 95% CI 0.6–6.8). In patients with type II fractures, the odds of mortality with severe AAI approached a 3-fold higher risk (OR 3.3; 95% CI 0.9–12.3). **Conclusion:** Patients with acute odontoid fractures and severe AAI may be more likely to experience nonunion and mortality, suggesting the possibility that aggressive management could be warranted. Further investigation with a large prospective study including patient-important functional outcomes is justified.

1.5.55

Peripheral hypersensitivity to subthreshold stimuli persists after resolution of acute experimental disc-herniation neuropathy. ***M. Shamji,*†* ***Y.-S. Tu,**** ***M. Salter.**** **From the *University of Toronto, and †Toronto Western Hospital, Toronto, Ont.**

Background: While acute disc-herniation induced radiculopathy most frequently resolves without clinical sequelae, a fraction of patients will experience long-term sensory or motor dysfunction. This study examined the chronic sensitivity of the rodent hindpaw after resolution of an acute inflammatory neuropathy. **Methods:** C57BL/6 mice underwent a surgical procedure with mid-thigh exposure of the sciatic nerve. Control animals underwent exposure only ($n = 8$) and experimental animals underwent placement of littermate tail nucleus pulposus ($n = 8$). Animals were evaluated throughout 3 weeks for mechanical allodynia by Von Frey testing, thermal hyperalgesia by heat withdrawal latency, cold allodynia by acetone testing, and gait stability by RotaRod testing, until the acute nociceptive phenotype resolved. Thereafter, animals were injected with intraplantar subthreshold capsaicin or vehicle alone, and the same behavioural testing was performed. At sacrifice, sciatic nerves were assessed for macrophage infiltration by immunohistochemistry, and dorsal root ganglion explants were assessed for capsaicin sensitivity for TRPV1 activation using cobalt staining. **Results:** Mice exposed to heterotopic nucleus pulposus (NP) stimulation demonstrated mechanical allodynia after subthreshold capsaicin delivery compared with both sham-operated controls or NP-stimulation animals delivered vehicle only. Intraneural macrophage infiltration observed at 1 week had dissipated by this 3 week time point. Dorsal root ganglia derived from NP-treated animals exhibited greater cobalt staining in response to capsaicin-induced TRPV1 channel activation compared with sham controls. **Conclusion:** Noncompressive disc herniation leads to altered long-term sensitization in the distribution of the sciatic nerve in this animal model. This sensitivity persists despite resolution of acute intraneural macrophage migration, and the demonstrated role of TRPV1 may provide insight into how acute inflammatory pain transforms into chronic neuropathic pain. Decreasing TRPV1 expression may prevent the development of the long-term painful phenotype.

1.5.56

Radiation induced lumbar spinal osteonecrosis: case report and literature review. ***J. Manson,**** ***A. Hadlow.**† **From *Northland DHB, Whangarei, New Zealand, and †Auckland DHB, Auckland, New Zealand**

Background: This report involved the presentation of a rare case of radiation-induced lumbar osteonecrosis with latency between exposure and presentation of over 30 years. **Methods:** We completed a case presentation and literature review. **Results:** Radiation induced lumbar osteonecrosis is very rare. Cervical spinal osteonecrosis is better described, attributable to use of radiotherapy in treatment of head and neck cancers. **Conclusion:** With modern planning of radiotherapy, this condition is probably less likely to be encountered in the lumbar spine. Cervical spinal osteonecrosis is much more common due to use of radiation in association with head and neck tumours, and should be borne in mind. Latency of many years between radiation exposure and development of osteonecrosis is common.

1.5.57

Comparative outcomes and cost-utility following surgical treatment of focal lumbar spinal stenosis compared with osteoarthritis of the hip or knee: Part 2 — estimated lifetime incremental cost-utility ratios. ***Y.R. Rampersaud,**** ***P. Tso,†* ***K. Walker,†* ***S.J. Lewis,**** ***J.R. Davey,**** ***N. Mahomed,**** ***P.C. Coyte.†* **From the *Department of Surgery, Division of Orthopaedic Surgery, Toronto Western Hospital, University Health Network, and the †Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ont.**

Background: To estimate the lifetime incremental cost-utility ratios (ICUR) for decompression (D) and decompression with fusion (DF) for focal lumbar spinal stenosis (FLSS) versus total hip and knee arthroplasty (THA/TKA) for osteoarthritis (OA) from hospital perspective based on long-term health status data at a median of 5 years (4–7 yr) postsurgical intervention. **Methods:** A single-centre, retrospective longitudinal matched cohort study of prospectively collected outcomes and retrospectively collected costs including patients with primary 1–2 level D or DF for FLSS ($n = 99$) and THA ($n = 99$)/TKA ($n = 99$) for primary OA. Incremental cost-utility ratios ($/QALY) determined using perioperative costs (direct and indirect) and Short Form-6D (SF-6D) utility scores converted from the SF-36. Utility modelled over the lifetime and quality-adjusted life years (QALYs) were determined using the median 5-year health status data. Primary outcome measure, cost per QALY gained, calculated by estimating the mean incremental lifetime costs and QALYs for each diagnosis group after discounting costs and QALYs at 3%. Sensitivity analyses adjusting for, +25% primary and revision surgery cost, +25% revision rate, upper and lower confidence interval utility score, variable inpatient rehabilitation rate for THA/TKA and discounting at 5%, were conducted to determine factors affecting the value of each type of surgery. **Results:** Follow-up and revision surgery data attained for FLSS (85%), THA (85%) and THA (75%) of the cohorts. Five-year ICURs were $21 702/QALY for THA; $28 595/QALY for TKA; $12 271/QALY for D; and $35 897/QALY for DF. Estimated lifetime ICURs using the median 5-year follow-up data was $5682/QALY for THA; $6489/QALY for TKA; $2994/QALY for D; and $10 806/QALY for DF. The overall spine (D and DF) ICUR was $5617/QALY. The estimated best and worst-case lifetime

ICURs varied from $1126/QALY for the best-case (D) to $39 323/QALY for the worst case (DF). **Conclusion:** Surgical management of primary OA of the spine, hip and knee results in durable cost-utility ratios that are well below accepted thresholds for cost-effectiveness.

1.5.58

A predictive model of progression for adolescent idiopathic scoliosis based on 3D spine parameters at first visit. ***M.-L. Nault,* J.-M. Mac-Thiong,* M. Roy-Beaudry,* I. Turgeon,* H. Labelle,* J. deGuise,† S. Parent.*** **From the *Hopital Ste-Justine, and †LIO, Montréal, Que.**

Background: Prediction of curve progression remains challenging in adolescent idiopathic scoliosis (AIS) at the first visit. Prediction of progression is based on curve type, curve magnitude and skeletal or chronological age. Three-dimensional consideration is becoming more and more popular in the scoliosis research community either for classification or treatment planning. The objective of this study was to develop a predictive model of the final Cobb angle in adolescent idiopathic scoliosis based on 3D spine parameters. **Methods:** A prospective cohort of 194 AIS was followed from skeletal immaturity to maturity (mean 37.4 mo). A total of 158 patients could be included in analyses (81%). Computerized measurements were done on reconstructed 3D spines radiographs of the first visit. There were 6 categories of measurements: angle of plane of maximum curvature, Cobb angles (kyphosis, lordosis), 3D wedging (apical vertebra, apical disks), rotation (upper and lower junctional vertebra, apical vertebra, thoracolumbar junction), torsion and slenderness (height/width ratio). A general linear model analysis with backward procedure was done with final Cobb angle (either just before surgery or at skeletal maturity) as outcome and 3D spine parameters as predictors. Skeletal maturity stage and type of curvature were also included in the model. **Results:** A predictive model was obtained with a determination coefficient (R^2) of 0.702. Included predictors were a 3-stage skeletal maturity system and type of curvature. The initial frontal Cobb angle was also included as well as the angle of the plane of maximal curvature. The 4 other predictors were the 3D wedging of 2 different disks level, and the apical intervertebral rotation. **Conclusion:** This study has led to the development of a predictive model of final Cobb angle in AIS based on information available at first visit. Based on this prospective cohort, the traditional parameters of Lonstein and Carlson (Cobb angle, chronological age and Risser sign) gave an R^2 of 0.488. It is the first time that 3D parameters are identified as risk factors of progression which supports the recent interest of 3D analysis in AIS.

1.5.59

Development of a clinical prediction model for surgical decision making in patients with degenerative lumbar spine disease. ***G. Hardy St-Pierre, A. Jack, R. Fox, A. Nataraj.*** **From the University of Alberta, Edmonton, Alta.**

Background: In Alberta for the fiscal year 2009 to 2010, over 25 000 lumbar spine magnetic resonance imaging (MRI) were performed as per "Appropriateness of Spinal Imaging use in Canada" CIHR Knowledge Synthesis project April 2013. We aimed to identify a low risk group of patients who would not benefit from lumbar MRI based on offered surgical treatment as an end point by creating a clinical prediction model. **Methods:** We performed retrospective analysis of prospectively collected data at the Kaye Edmonton Clinic on 200 randomly selected patients from 2009 to 2013. Variables collected were age, work status, litigation, narcotic use, alcohol use, smoking status, medical comorbidity, psychiatric comorbidity, conservative management, sensory deficit, motor deficit, bowel/bladder/sexual symptoms, prior spine operation, claudication, leg dominant pain, back dominant pain, body mass index (BMI), duration of pain, pain improving and neural compression on MRI. A decision analysis model was used, with logistic regression analysis for the odds of having surgery based on the clinical symptoms. **Results:** We performed multivariate logistical regression analysis which revealed 3 variables leading to a convergent model: leg dominant pain (odds ratio [OR] 62.3), claudication (OR 5.80), and high BMI (OR 0.91). Two additional variables did not take part in the best convergent model but when absent were 100% predictive of not offering surgery: improving pain and neural compression on MRI as judged by the surgeon. All other variables were non-significant including those derived from the physical examination. **Conclusion:** The absence of improving pain, presence of leg dominant pain, presence of claudication, low BMI and presence of neural compression on MRI were sufficient to predict all patients offered an operation irrespective of physical exam findings, prior operation, prior conservative management or other patient characteristics. We now need to validate our model with an alternate data set.

2.5.60

Canadian spine surgery fellowship education: evaluating opportunity in developing a nationally based training curriculum. ***J. Larouche,*† S. Paquette,† T. Leroux,* A. Yee,* H. Ahn,* R. Broad,‡ C. Fisher,† H. Hall,* A. Nataraj,‡ D. Hedden,‡ S. Christie,§ T. Carey,¶ V. Mehta,‡ M. Fehlings,* V. Wadey.**** **From the *University of Toronto, Toronto, Ont., †University of British Columbia, Vancouver, BC, ‡University of Alberta, Edmonton, Alta., §Dalhousie University, Halifax, NS, and the ¶University of Western Ontario, London, Ont.**

Background: Our primary aim was to determine the perceived needs of the Canadian Spine Society Membership and Executive Committee in developing a nationally based curriculum in spine surgery fellowship education. Our secondary aim was to determine the perceived barriers as well as opportunities in enhancing fellowship education. **Methods:** A survey was administered to the CSS membership in advance of the CSS 2012 Annual Scientific Conference. Respondents represented both academic as well as community practice as well as backgrounds training including both orthopaedic as well as neurosurgical residency. In October 2012, we also administered a similar survey independently to the CSS executive committee during their semiannual meeting. **Results:** Forty-nine individuals responded to our pre-2012 Annual Scientific Conference of the CSS survey. Results indicated that 86% of respondents believed that it was necessary to develop specific curricula and/or competencies in spine fellowship training. Less than half (41%) considered it important to consider background residency training either in neurosurgery or orthopaedic surgery. When questioned about awareness of

certification, 63% reported to be aware of the American Board of Spine Surgery opportunity in recognizing spine surgery training in the US, and 71% were also aware of the Royal College of Physicians and Surgeons of Canada (RCPSC) Areas of Focused Competency (AFC) diploma opportunity in recognizing fellowship education. Given these facts, 68% indicated that formal recognition of spine surgery fellowship training at the RCPSC level was desirable. Seventeen surveys of the CSS executive committee (100% response rate) were obtained. A total of 94% of respondents indicated that fellowship training in Canada can and should be improved including the development of a nationally based curriculum. Perceived opportunities and barriers included consideration of background residency training considering existing RCPSC specialty spine rotation specific objectives, the potential impact on current spine referral patterns and clinical practice, as well as funding that may be required to support an enhanced and more formalized fellowship medical education opportunity. **Conclusion:** In Canada, there remains interest in developing a nationally based curriculum in spine surgery fellowship education. This study motivates ongoing educational research aimed at developing as well as guiding the implementation of this curriculum. An expert consensus Delphi-approach is currently underway to explore both cognitive as well as procedural competencies deemed important at the fellowship level.

2.5.61

Pedicle subtraction osteotomy for severe proximal thoracic junctional kyphosis. ***S. Lewis,* T. Dear,* M. Hashem.†***
From *Toronto Western Hospital, and the †Hospital for Sick Children, Toronto, Ont.

Background: Severe proximal thoracic deformities are often seen following fusion to the upper thoracic region for kyphotic deformities. Addressing the deformity while limiting the extent of cervical fusion can be challenging. We present a series of 5 cases managed with proximal thoracic pedicle subtraction osteotomy (PSO) with limited proximal extension of the instrumentation. **Methods:** The charts and radiographs were reviewed of 5 patients treated with a PSO for severe kyphotic deformities proximal to their constructs. All patients underwent a posterior based PSO at T2, T3 or T4, with extension of the construct 2 levels proximal. A central rod using centrally placed laminar hooks was used to close the osteotomy in all cases, then removed once the 2 lateral rods were placed in 4 of 5 cases. A 4.5 rod diameter was preferred in these cases. Statistical analysis was performed on the radiographic measures. **Results:** Three patients with Scheuermann's kyphosis, one nonambulatory neuromuscular, and 1 kyphotic AIS developed early severe proximal junctional kyphosis proximal to their construct. The PSO was performed at T2 in 1 case, T3 in 3 cases, and T4 in 1 case. One patient presented pre-PSO with acute paraplegia 2 weeks following the index scoliosis surgery, the remainder were neurologically intact and were treated electively. The mean preop kyphotic angle was 61.2° (50°–81°) and improved to 20.6° (11°–32°) (p = 0.0005). The mean thoracic kyphosis T2-T12 improved from 74.8° (60°–95°) to 49.4° (31°–77°) (p = 0.04). The correction was maintained at final follow-up. No new neurologic deficits occurred. A near complete return of neurologic function to baseline occurred in the neuromuscular nonambulatory patient that presented with deficits. Because of poor head control, the neuromuscular patient subsequently had the instrumentation extended to C2. The remaining patients did not require any further procedures. **Conclusion:** A proximal thoracic PSO is an effective means of achieving large corrections for severe junctional kyphosis. A mean correction of 40° was achieved. The use of a central rod greatly facilitated correction and limited the compression forces required on the pedicle screws to achieve correction. Extension of the fusion into the cervical spine was not required in our ambulatory patients.

2.5.62

A comparison of spine surgery referrals triaged through a multidisciplinary care pathway versus conventional referrals. ***C. Wilgenbusch, D. Fourney.*** **From the University of Saskatchewan, Saskatoon, Sask.**

Background: The Saskatchewan Spine Pathway (SSP) was introduced based on evidence that a coordinated, multidisciplinary and stratified approach to the assessment and management of low back pain (LBP) may improve quality. During early implementation, some physicians began to refer patients to SSP clinics, while others continued to refer patients directly to the surgeon through the conventional process. The objectives of this study were to: 1) determine if referrals from SSP clinics (group A) were more likely to be candidates for surgery than conventional referrals (group B); 2) determine relevant clinical differences in the groups (e.g., diagnosis, pain scores, level of disability); and 3) compare wait times for magnetic resonance imaging (MRI) and surgeon assessment. **Methods:** A retrospective review of prospectively acquired data from consecutive new outpatient referrals for lower back pain and leg pain, June 1, 2011, through May 30, 2012, for 2 surgeons was performed. **Results:** We identified 215 referrals for lower back and leg pain, including 66 (30.7%) in group A and 149 (69.3%) in group B. There was no difference in overall pain score (mean EQ5D VAS) or lower back-related disability score (Oswestry Disability Index). Group A patients were significantly more likely to be surgery candidates (59.1% v. 37.6% for group B; p = 0.0034, χ^2 test), had significantly poorer scores for EQ5D mobility, a higher proportion of leg dominant pain, and a lower proportion of back dominant pain. Patients referred through the SSP also had significantly shorter wait times for MRI and assessment by the surgeon. **Conclusion:** A coordinated multidisciplinary pathway with a stratified approach to LBP assessment and care selected more appropriate candidates for surgery than the conventional referral process. The implementation of such processes may allow surgeons to restrict their practices to patients who are more likely to benefit from their services, thereby reducing wait times.

2.5.63

Results and complications of posterior-based 3 column osteotomies in patients with previously fused spinal deformities. ***S. Lewis, S. Goldstein, A. Bodrogi, M. Lipkus, T. Dear, S. Keshen.*** **From Toronto Western Hospital, Toronto, Ont.**

Background: To present the clinical and radiological results of a 1-stage posterior-only vertebral column resection (VCR) or pedicle subtraction osteotomy (PSO) through a fusion mass in cases of revision spinal surgery. **Methods:** Twenty-six consecutive previously fused patients underwent a PSO (n = 27) or VCR (n = 8)

through the fusion mass for persistent spinal deformity by a single surgeon. Preoperative, postoperative, and final follow-up anteroposterior and lateral 36-inch standing radiographs were analyzed to compare coronal and sagittal Cobb angles and balance. Osteotomy correction was also measured at the final follow-up. Perioperative and postoperative complications were evaluated. Patients' functional results were evaluated using Oswestry Disability Index (ODI) and Scoliosis Research Society-30 (SRS-30) questionnaire scores. Patients were grouped into either the combined group (coronal Cobb ≥ 30°) or the sagittal-only group (Coronal Cobb < 30°). **Results:** Average follow-up was 31.6 months. For the 14 patients in the combined deformities group, the mean measurable coronal Cobb angle, coronal osteotomy angle and apical vertebral translation improved from preoperative 49.9°, 20.3° and 50.8 mm to postoperative 35.6° ($p = 0.03$), 14.4° and 38.1 mm, respectively, which were maintained at the latest follow-up. For the sagittal-only group, the mean sagittal balance improved from preoperative 100.7 mm to 26.1 mm ($p < 0.05$). For all 34 patients, the mean osteotomy correction was 25.4° ($p < 0.0001$), with an improvement of 27.2° and 24.0° in the sagittal-only and combined group, respectively. Mean operative time was 7.5 hours with an average 12-level fixation. Twenty-three patients had at least 1 major or minor complication. There was 1 postoperative death. Two experienced proximal junctional kyphosis following fixation, which then required revision procedures. All SRS-24 categories showed improvement in terms of the mean scores, however only the self-image, satisfaction, and the overall categories showed significant improvement ($p = 0.003$, $p = 0.003$ and $p = 0.002$, respectively). As there was no preoperative pain in this group of patients, their ODI scores remained unchanged. **Conclusion:** Our study showed that similar amounts of curve correction can be achieved with a PSO or VCR in previously fused spines compared with primary procedures. The clinical outcome and complication rate was comparable to the literature for osteotomies.

2.5.64

Orthopaedic Surgical AdVerse Event Severity (Ortho-SAVES) system: identifying opportunities for improved patient safety and resource utilization.

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From the *Division of Orthopaedic Surgery and Neurosurgery, Department of Surgery, University of Toronto, †Arthritis Program, Toronto Western Hospital, University Health Network, ‡Spinal Program, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, and §Shoulder and Elbow Reconstructive Surgery, Toronto Western Hospital, University Health Network, Toronto, Ont.

Background: The main objectives of this project were to identify factors predicting adverse events (AEs) in orthopaedic and spine surgery, and to identify the clinical and resource impacts of AEs. **Methods:** Comprehensive data were prospectively collected on 3453 consecutive in-patient orthopaedic and spine surgeries at Toronto Western Hospital between January 2011 and December 2012. Measured outcome variables included number, type and severity of adverse events according to the validated adverse event severity grading system, as well as length of stay (LOS) and patient-level cost. Odds of having an adverse event was modelled with multiple logistic regression. Length of stay and cost were modelled as outcomes of multiple linear regression. **Results:** Twenty-nine percent of all inpatients developed at least 1 AE; 7% had more than 1. The majority of patients who had adverse events had low severity AEs (grade I-II). The most common postoperative AEs were urinary tract infections (UTIs), delirium, and urinary retention. The odds of having an AE were higher in patients over age 65 with worse preoperative ASA status and longer operating times; gender, obesity and diagnosis were not significant predictors. Dependent on anatomic site, AEs accounted for increases in LOS of 1.5 to 7.6 days and cost of $1800 to $18 700. Adverse events were associated with the highest increases in LOS and cost in spine patients: having an AE predicted LOS 7.6 days longer and cost $18 689 higher in this subgroup. As UTIs were found to account for a large proportion of AEs, a protocol designed to lower the UTI rate in the spine population was implemented and UTI incidence fell from 5% to 2%. **Conclusion:** Adverse events are associated with significantly higher LOS and cost in orthopaedic surgery — especially in spine surgery. Reduction and prevention of adverse events may lead to significant savings in hospital resources.

2.5.65

Spontaneous spinal extra-axial haematomas — surgical experience in Otago and Southland 2011–2013.

R. Johnson, S. Perera, A. Taha. **From the University of Otago, Otago, New Zealand**

Background: We studied spontaneous spinal extra-axial haematomas (SSEAH) based on surgical experience in Otago and Southland from 2011 to 2013. **Methods:** We completed a retrospective review of clinical series and review of the literature. **Results:** Six adult patients underwent surgery for SSEAH with age ranging from 39–75 years (mean 47 yr) and there was also 1 pediatric patient (5 mo). All adult patients presented with back pain and all but 1 had evidence of neurologic compromise (paralysis or sensory deficit). The hematomas spanned 1 to 7 segments (mean 3) with thoracic spine involvement in 4 patients and isolated to the cervical spine in 2 patients and the lumbar spine in 1 patient. Five out of 6 patients underwent surgery within 72 hours of presentation. All patients underwent posterior decompression. The hematoma was epidural in all but 1 patient who had a subdural hematoma. No underlying cause was found in 4 patients. AVM was confirmed in 2 patients and a disc herniation in 1 patient. Complete neurologic recovery has been seen in 4 patients at follow-up to date. **Conclusion:** A SSEAH is a rare entity with varying underlying pathology. Prompt diagnosis and surgical intervention are necessary to achieve functional recovery.

2.5.66

Obesity and spinal epidural lipomatosis in cauda equina syndrome.

D. Cushnie, J. Urquhart, K. Gurr, F. Siddiqi, C. Bailey. **From Western University, London, Ont.**

Background: To test the hypotheses that patients with an acute disc herniation and cauda equina syndrome (CES) have a greater body mass index (BMI) and greater quantity of epidural fat

compared with control patients surgically treated for a lumbar herniated disc without CES. **Methods:** Thirty-three CES and 66 control subjects were identified from a prospective spine surgical database containing patients undergoing surgery between 2007 and 2012 at an academic spine centre in Canada. Two control patients were age matched within 5 years and sex matched to each CES subject. Relevant biometrics including weight, height, age, and gender was extracted from medical records. Patients were classified by the World Health Organization (WHO) Obesity Classification (2000). Percentage of lumbar spinal canal occupied by fat was measured on the midline sagittal magnetic resonance images using the method described by Borré and colleagues (2003) modified to compensate for herniation. Measurements were perpendicular to the posterior L4 vertebral body at 50% vertebral body height level. Student *t* test and confidence intervals (95% confidence interval [CI]) were used to compare BMI, WHO obesity classification, and percentage canal epidural fat between the CES and control group. **Results:** The CES cases had higher BMI (32.3 [95% CI 29.4–35.2]) than controls (27.7 [95% CI 26.8–29.3]; $p = 0.007$) and were less likely to be normal weight ($p = 0.042$). CES cases also had a significantly greater percentage of spinal canal occupied by epidural fat (32.9% [95% CI 27.9%–38.0%]) than controls (22.6% [95% CI 18.9%–26.2%]; $p = 0.001$). **Conclusion:** Obesity is confirmed as a risk factor for CES. This association may be due to increased epidural fat deposits.

2.5.67

Factors affecting restoration of lumbar lordosis in adult degenerative scoliosis patients treated with lateral transpsoas interbody fusion. ***S. Sridharan, K. Thomas, R. Cho, G. Swamy.*** **From the University of Calgary, Calgary, Alta.**

Background: We studied whether technical factors under the surgeon's control affected the ability to generate lordosis in lateral trans-psoas interbody fusion (LTIF) during multiple cage insertion in adult degenerative scoliosis (ADS). **Methods:** The ADS patients undergoing multiple LTIFs were identified at our institution. All patients had a second stage percutaneous instrumentation. Patients that underwent LTIFs of levels L1 to L5 (± T12), had complete imaging (X-ray and computed tomography or magnetic resonance imaging), and that had a minimum 6-month follow-up were included. All LTIFs used were of a fixed anterior–posterior width and lordosis (6°). Digital Cobb technique was used for measuring segmental and regional angles. Degree of anterior cage placement was measured using a novel technique. **Results:** A total of 37 patients (mean age 63 yr; 81% female) were included. The LTIF significantly reduced both segmental coronal balance (significant reduction at each level, average reduction of 3.7° [$p < 0.05$]) and regional coronal balance (preoperatively: 22.8° ± 12.5°; follow up: 10.5° ± 8.5°; $p < 0.05$). Segmental sagittal balance improved significantly at each level (average segmental lordosis gain of 5.0° ± 5.3°; $p < 0.05$). Regional sagittal balance (lumbar lordosis) improved significantly from –35.4° ± 14.9° preoperatively to –46.0° ± 15.9° at follow up ($p < 0.05$). The mismatch between pelvic incidence and lumbar lordosis was significantly reduced following LTIFs (preoperatively: 21.8 ± 13.6; follow up: 11.0 ± 13.8; $p < 0.05$). Increasing anterior placement of the cage correlated with increased segmental lordosis at each level ($p < 0.05$), while follow-up disc height correlated significantly at the L3-L4 and L4-L5 levels. Lumbar lordosis correlated with degree of anterior cage placement at L3-L4 ($\rho = 0.35$) and L4-L5 ($\rho = 0.34$) and follow up disc height at L3-L4 ($\rho = –0.51$) and L4-L5 ($\rho = –0.31$). **Conclusion:** Lateral transpsoas interbody fusion with percutaneous posterior instrumentation significantly improves both regional and segmental coronal and sagittal balance and reduces the mismatch between lumbar lordosis and pelvic incidence. Attention to surgical technique in placement can increase segmental lordosis, specifically by increasing the height and anterior placement of the LTIF.

3.6.68

Systematic review of complications in spinal surgery: a comparison of retrospective and prospective study design. ***J. Street,‡ C.L. Power,*† S. Henari,*† B. Lenehan.*†*** **From the *University of Limerick Graduate Entry Medical School, †University Hospital Limerick, Limerick, Ireland, and the ‡CNOSP Vancouver General Hospital, University of British Columbia, Vancouver, BC**

Background: To systematically review the existing literature relating to complications of spinal surgery, examining for a consensus of complications across papers and evaluating the merits of prospective versus retrospective study design. **Methods:** The keywords "spine surgery" and "complications" were chosen, and a Medline search was performed for the years 1992 to 2010. We reviewed English language publications from core spine journals, dealing with predominantly adult, nononcology patients. Case reports were excluded. All abstracts were reviewed by 2 authors (S.H. and B.L.), with consensus reached on any disagreements for inclusion. In each publication we noted the site of surgery, study design, year of publication, duration of follow-up, complication type, subject matter, procedure level and method of complication collection. Mean follow-up duration values were obtained from the individual reports. Unclear or missing values were noted as such. All data was inputted on an Excel database. **Results:** Of 832 relevant publications, 177 met our inclusion criteria. There were 120 retrospective reviews and 57 prospective studies. This review yielded 2 249 868 patients, with an average follow up of 33 months. The reported complication rate averaged 21.19% (range 0%–86%). Prospective studies had a higher overall reported complication rate of 22.2%, while retrospective studies reported an average of 19.9%. Seventeen of 120 retrospective studies reported no complications or failed to mention them, compared with 6 of 57 prospective studies. Across articles there was no clear consensus of complications or consistent reporting system. **Conclusion:** This study identified a significant rate of complications relating to spinal surgery. In addition, we identified that prospective study design is more effective when accounting for these surgical complications. This finding combined with the lack of a clear consensus or consistent reporting across articles reinforces the conclusion that complications of spinal surgery represent a significant issue that is best studied prospectively with adherence to strict study controls.

3.6.69

Postsurgical rehabilitation patients have similar fear avoidance behaviour levels as those in nonoperative care. ***C. Gregg,* G. McIntosh,† H. Hall,† C. Hoffman.**** **From *The Back Institute, Wellington, New Zealand, and the †CBI Health Group Research Department, Toronto, Ont.**

Background: The Tampa Scale for Kinesiophobia (TSK) is a commonly used as a measure of pain-related fear of movement and is often used in the clinical setting to detect patients at greater risk of developing long-term chronicity. The effect of spine surgery on baseline TSK levels is uncertain and limits the development of appropriate postoperative care. The purpose of this study was to measure baseline and change in fear avoidance levels for those with previous spine surgery commencing active rehabilitation compared with nonsurgical LBP patients. **Methods:** This was a prospective study of LBP cases (n = 305) treated at 4 spine care rehabilitation clinics in New Zealand between January 2008 and October 2012. In addition to baseline data on pain, function, and sociodemographics, all patients completed the TSK at assessment and discharge from treatment. All patients had mechanical LBP with no abnormal neurology, as determined by the Saskatchewan Spine Pathway triage methodology. **Results:** Of the 305 cases, 129 (42.2%) stated they had previously had spine surgery and 176 (57.8%) had been managed nonoperatively. There were no baseline statistically significant differences between groups for: medication use, gender, pain classification, SLR testing, numeric pain rating, perceived function or work status. The median symptom duration for the surgical group was 367 days (7% acute, 93% chronic) and nonsurgical was 118 days (39% acute, 61% chronic). The surgery group had significantly better (less fear) baseline TSK scores (39.9 v. 42.0, p < 0.008). At the conclusion of rehabilitation, there was no statistically significant difference in the reduction of TSK scores between groups. **Conclusion:** Postsurgical patients had less fear avoidance than those treated nonoperatively, at baseline. Surgery did not have a negative consequence on fear avoidance changes following rehabilitation. Postsurgical patients do not require additional rehabilitation input to address kinesiophobia than that provided to nonoperative patients.

3.6.70

Outcomes of surgical treatment of adolescent spondyloptosis: a case series. *P. Missiuna, A. Karachi, T. Pazionis, O. AlShaya.* From McMaster University, Hamilton, Ont.

Background: Severe isthmic spondylolisthesis and spondyloptosis are commonly treated with in situ fusion. Improvements in surgical instrumentation technology and surgical techniques facilitate improved outcomes in terms of reduction and fusion. However, surgical intervention should only be attempted if perceived benefits outweigh perceived risks. This study assesses functional results and effect of reduction and fusion of the lumbar spine on adolescent patients with L5 spondyloptosis compared with the existing literature on in situ fusion. **Methods:** Medline, Embase and Cochrane searches were performed to review existing literature regarding reduction and fusion vs. in situ fixation of spondylolisthesis and spondyloptosis. Sited results were used as a background for our case series. Between 1994 and 2010, 6 adolescent patients 3 or more years postsurgery for severe L5 spondylolisthesis presented to McMaster University Medical Centre for examination, assessment and treatment. All patients underwent reduction and posterior instrumented fusion and had pre- and postoperative functional assessments and quality of life questionnaires administered. X-ray assessment was conducted preoperatively to confirm diagnosis, intraoperatively and at routine postoperative appointments to monitor fixation. All patient outcomes were reviewed and assessed independently of the operating surgeon. **Results:** Two female and 4 male patients are reported in this case series with an average age of 14.5 years. Patients were followed post operatively for a minimum of 3 years. Four of 6 patients initially had radiative pain or numbness to a leg which improved postoperatively. No patients underwent revision. One patient had a sensory deficit and hyperreflexia which improved within 1 year postoperatively. All patients cited improvement in functional status, improvement/resolution of preoperative symptoms, and satisfaction with body habitus postoperatively. **Conclusion:** Reduction and instrumented fusion of the lumbar spine for L5 severe spondylolisthesis patients was an acceptable alternative to in situ fusion on the patients reported in our case series. The surgical procedure is highly technical, and some complications are to be expected post operatively. We did not observe any permanent neurologic compromise in our study patients. Our results suggest superior outcomes with reduction and posterior instrumented fusion and should be considered as a viable alternative to in situ fusion when performed by an experienced surgeon.

3.6.71

Surgical success in primary versus revision thoracolumbar spine surgery. *E.P. Abraham,*† A.J. Green,* M. McKeon,* N.A. Manson.*†* From *Saint John Regional Hospital, and †Dalhousie Medicine, Saint John, NB

Background: Surgical success is predicated on multiple factors including appropriate surgical decision-making, surgical complexity, and patient expectations. Understanding the differences between primary thoracolumbar surgery (PTL) and revision thoracolumbar surgery (RTL) outcomes may guide surgical decisions and optimize preoperative patient counselling, thus improving outcomes. This study aimed to assess differences in intraoperative morbidity and patient-reported outcomes between PTL and RTL surgery. **Methods:** A total of 245 consecutive adult patients were identified from a prospective spine surgery outcomes database (PTL n = 183, RTL n = 62). Outcomes measures included Short-Form 36 (SF-36) physical component summary (PCS) and mental component summary (MCS), Modified Oswestry Disability Index (ODI), back and leg pain numerical rating scales (NRS-Back; VAS-Leg), and patient satisfaction questions administered at baseline and 2, 6, 12 and 24 months after surgery. **Results:** Several significant group differences were detected — all of which indicated higher success for PTL surgery than RTL surgery: less blood loss (p < 0.001), greater improvement in physical functioning (p = 0.017), greater reduction of pain-related disability (p = 0.048), greater relief of leg pain (p = 0.020), and higher self-reported satisfaction (p = 0.044). However, it is important to note that despite significantly greater improvement in the PTL group, both groups achieved minimum clinically important differences. **Conclusion:** As expected, RTL patients demonstrated significantly less benefit from surgery than PTL patients. However, both groups did reach minimum clinically important differences; therefore RTL procedures still represent significant patient improvement. Understanding this difference may help guide patient expectations and surgical decision-making. Future research should aim to better understand the underlying mechanisms of these differences, and to assess whether or not there are different patterns within specific surgical techniques and/or pathologies.

3.6.72

The effect of smoking on subjective patient outcomes in thoracolumbar surgery. ***E.P. Abraham,*† A.J. Green,* M. McKeon,* N.A. Manson.*†*** **From *Saint John Regional Hospital, and †Dalhousie Medicine, Saint John, NB**

Background: The effect of smoking on spine surgery outcomes is well documented: smoking has a significant negative effect on fusion rates, re-operation, and adverse events. These results are highly valuable; however, there is a paucity of information about the effect of smoking on subjective patient outcomes after spine surgery. These measures may be more relatable to patients, and could provide stronger evidence for motivating surgical candidates to cease smoking. This study aimed to examine differences in surgical outcomes between patients who smoke, patients who do not smoke, and patients who cease smoking for surgery. **Methods:** A prospective spine surgery outcomes database identified 336 consecutive adult patients, who were then categorized into nonsmoking (n = 217), smoking (n = 84) and ceased smoking (n = 35) groups based on self-reported smoking habits. Minimum follow-up was set at 1 year. Outcomes measures included the Short-Form 36 (SF-36) Physical Component Summary (PCS) and Mental Component Summary, back and leg pain numerical rating scale (NRS-Back; NRS-Leg), and modified Oswestry Disability Index (ODI) scores. **Results:** Multivariate analyses of variance (MANOVAs) showed significant group differences in mental health functioning (p = 0.008), NRS-Back (p = 0.004), and NRS-Leg scores (p = 0.024). Tukey's honest significant difference post hoc analyses revealed that the nonsmoking group received greater benefit from surgery than the smoking group on all 3 measures. Observed power was insufficient for PCS and ODI scores in this sample. The ceased smoking group did not show significant differences from either group, though means tended to be between both groups. With greater power, these differences might be more apparent. **Conclusion:** This study suggests a negative effect of smoking on patient-perceived outcomes following thoracolumbar surgery. Preoperative smoking cessation appears to move outcomes toward those of nonsmokers; however, further investigation is required. Future research should evaluate biopsychosocial factors contributing to this relationship and examine smoking cessation criteria that optimizes patient outcomes.

3.6.73

Modelling patient recovery to predict outcomes following elective thoracolumbar surgery for degenerative pathologies. ***N.A. Manson,*† A.J. Green,* M. McKeon,* J. Murray,‡ E.P. Abraham.*‡*** **From *Saint John Regional Hospital, †Dalhousie Medicine, Saint John, NB, and the ‡Horizon Health Network, Moncton, NB**

Background: While a multitude of demographic and surgical factors have been shown to affect patient outcomes, identifying appropriate candidates for thoracolumbar surgery can be complex. This study aimed to identify the accuracy with which a number of baseline variables predict patient recovery trajectories from baseline to 2 years after thoracolumbar surgery. **Methods:** A prospective spine surgery outcomes database identified 295 consecutive adult patients without malignancy or spine-related litigation. SF-36 Physical Component Summary (PCS), Mental Component Summary (MCS), and Modified Oswestry Disability Index (ODI) were administered at 6, 12, 24 months postsurgery. Additional information was collected through chart reviews. A latent class growth analysis explored subclasses of patient recovery for each outcome variable. This novel method identifies the number of classes (patient recovery patterns) that best describe the data, variables that best predict class membership, and the accuracy of these predictions. **Results:** There was evidence for a 3 common recovery patterns for PCS and MCS, and 4 common recovery patterns for ODI. In all 3 measures, poorer baseline scores were associated with less benefit after surgery, keeping in mind that high PCS and MCS scores indicate greater functioning, while low ODI scores indicate less pain-related disability. PCS and MCS classes were labelled high baseline improvers (HBI, 31.1% and 56.6%), medium baseline improvers (MBI, 40.4% and 33.6%), and low baseline nonimprovers (LBNI, 28.5% and 9.8%). The ODI classes were labelled low baseline improvers (LBI, 37.7%), MBI (35.5%), HBI (22.7%), and high baseline nonimprovers (HBNI, 4.0%). Factors including age, body mass index, comorbidites, education, previous surgery and surgical approach predicted class membership. **Conclusion:** This is a novel statistical technique presently underused in patient outcome modelling. While these results do not indicate a cause-effect relationship, they do highlight factors that may be most important in predicting patients' recovery patterns, and thus outcomes. Future research should aim to determine if patterns differ between pathologies.

3.6.74

Outcomes from trans-psoas versus open approaches in the treatment of adult degenerative scoliosis. ***E. Huang,* K. Thomas,† S. Suttor,‡ T. Goyal,† J. Littlewood,† I. Bains,† J. Bouchard,† R. Hu,† B. Jacobs,† R. Cho,† G. Swamy****** **From the *University of Alberta, Edmonton, Alta., †University of Calgary, Calgary, Alta., and ‡Westmead Hospital, Sydney, Australia**

Background: Staged trans-psoas/percutaneous posterior fusion in adult degenerative scoliosis has a lower incidence of complications and improved health-related quality of life (HRQOL) as compared with classic open surgery. **Methods:** Consecutive patients from 2007 to 2012 with adult degenerative scoliosis were included. Cephalad fusion level was T10/11 and caudad level was S1/ilium. Seven patients underwent open posterior decompression fusion with a pedicle screw-rod construct, employing Smith–Peterson osteotomies as needed (OPEN group). Fourteen patients underwent multilevel trans-psoas direct lateral interbody fusion, followed by staged percutaneous posterior pedicle screw-rod constructs (trans-psoas group). A transforaminal lumbar interbody fusion or anterior lumbar interbody fusion was used at L5/S1 in both groups. Patients with higher complexity osteotomies (e.g., pedicle subtraction osteotomy.) were excluded. Patients with incomplete clinical, radiographic or outcomes data were also excluded. Minimum follow-up was 12 months. Data collection consisted of patient demographics, operative detail, and immediate postoperative complications. Radiographic measurements included pre- and postoperative lumbar lordosis (LL), thoracic kyphosis (TK), pelvic tilt (PT) and sagittal vertical axis (SVA), with successful radiographic outcomes as outlined by Lafage et al. Oswestry Disability Index (ODI), Scoliosis research society (SRS) and SF-36 scores were compared between groups at

1 year postoperatively using parametric analyses. **Results:** Demographics were similar between the 2 study groups. The OPEN group had greater blood loss than the trans-psoas group (5000 ± 2700 mL v. 850 ± 500 mL, $p < 0.0001$) and higher blood transfusion rates (5.9 ± 1.8 units v. 1.2 ± 0.4 units, $p = 0.003$). There was no difference in length of stay or total operative time. Six of the 7 patients in the OPEN group suffered a major complication and no minor complications were recorded. One of 14 patients in the trans-psoas group suffered a major complication, and 7 of the 14 patients had a minor complication. Postoperative radiographic outcomes were similar between groups. In the OPEN group, 5 of 7 patients had PT under 25 and 4 of 7 had SVA under 50 mm. In the trans-psoas group, 10 of 14 patients had PT under 25 and 9 of 14 had SVA under 50 mm. Postoperative SRS (2.7 ± 0.2 OPEN v. 3.5 ± 0.2 trans-psoas, $p = 0.005$) and ODI (50.9 ± 9.3 OPEN v. 32.2 ± 4.0 trans-psoas, $p = 0.04$) scores were significantly different favouring the trans-psoas group. **Conclusion:** The treatment of adult degenerative scoliosis with a 2-staged trans-psoas/percutaneous posterior instrumentation resulted in significantly less blood loss and major complications than the OPEN group. Both techniques improved radiographic parameters. Pre- and postoperative SRS and ODI scores were significantly better in the trans-psoas group. This study, although limited by small numbers, suggests that operative management of adult degenerative scoliosis is best done by less invasive techniques, and provides pilot data for a larger multicentre study.

3.6.75

Lumbar spinal stenosis and presurgical assessment: the impact of walking induced strain on a performance-based outcome measure. ***S. Passmore, M. Johnson, V. Pelleck, Y. Amad, E. Ramos, C. Glazebrook.*** **From the University of Manitoba, Winnipeg, Man.**

Background: Following surgery, measurement of patient ability is as important as disability. Pre- and postsurgical objective performance-based outcome measures for degenerative lumbar spinal stenosis (LSS) patients are not yet established for clinical use. Activities of daily living, like walking, induce strain, motivating LSS patients to seek surgical intervention. The objectives of this study were to apply a recently established performance measure with alterable levels of difficulty to assess movement of presurgical LSS patients under conditions of strain, and no strain. **Methods:** The LSS patients ($n = 16$) and healthy controls ($n = 16$) performed 2 blocks of great toe pointing movements to a series of projected squares with different levels of difficulty. Following block 1 participants completed a 12-minute progressive exercise treadmill test (PETT). Pointing movements were recorded and analyzed using 3D motion analysis. Behavioural and kinematic measurement techniques evaluated performance pre- and post-treadmill walking. The Health Research Ethics Board approved all procedures. **Results:** The LSS patients self-selected to spend less time on the treadmill due to symptom onset ($t_{30} = 1.846$; $p = 0.03$). Both groups' movement times (MT) lengthened as task difficulty increased. A group by movement time interaction revealed LSS patients were more adversely impacted ($F_{3,372} = 6.724$; $p < 0.001$). The PETT facilitated reaction time for both groups ($F_{1,124} = 5.105$; $p = 0.026$). Control participants were less variable in time to peak velocity poststrain, a benefit not shared by LSS patients, ($t_{31} = 2.149$; $p = 0.040$). **Conclusion:** This study replicated that the present performance based outcome measurement differentiates between healthy and LSS participants. The role of strain was sufficient to prevent LSS participants from demonstrating improvement in the variability of their ballistic phase of movement execution. Based on the attained results future surgical intervention studies may use this performance outcome measure with strain to assess patient ability following surgical intervention.