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Fairmont Le Château Frontenac Québec, Quebec

Du mercredi 9 mars au samedi 12 mars 2011

Abstracts • Résumés

Canadian Spine Society abstracts

Podium presentations

THURSDAY, MARCH 10, 2011

1.1.01

Sleep quality and disability in spine patients. ***M. Zarrabian, M. Johnson, M. Goytan, R. Pryce, D. Kriellaars.*** **From the University of Manitoba, Faculty of Medicine, Winnipeg, Man.**

Background: Sleep is a relatively undisturbed topic in spine research. One would surmise that pain associated with disability will disrupt sleep; however, an equally important assertion is that poor sleep (independent of pain) will enhance morbidity or pain itself. Our purpose was to characterize sleep in spine patients. **Methods:** Participants (n = 79; 45 male, 34 female) were recruited with heterogeneous diagnoses. Participants completed the Oswestry Disability Index (ODI), a back and leg visual analogue scale (VAS; 100 mm), a VAS for the effective domain of pain (no effect, incapacitated) and the Pittsburgh Sleep Quality Index (PSQI). **Results:** The mean for age was 52.5 (SD 16.2) years and for BMI was 29.3 (SD 5.6). Pain intensity scores were 52 (SD 26) and 49 (SD 32) for the leg and back, respectively. This pain was rated to have a moderate-to-strong negative impact on functional ability. Severe disability was evident with an ODI of 55 (SD 13.7). The mean PSQI was 12 (SD 4.46), with 95% scoring greater than 5 (sleep disordered). The PSQI score was correlated with the ODI score ($r = 0.43$, $p < 0.001$). The 7 subscales of the PSQI were all also significantly correlated ($r > 0.25$ and < 0.47). We performed step-wise regression (ODI dependent; PSDI, VASs, age, BMI as independents). The PSQI was retained in the model with 2 pain measures ($r^2 = 0.637$, $p < 0.001$). The 7 subcomponents of the PSQI were substituted for the PSQI in the regression model, to reveal 3 subcomponents (sleep quality, sleep efficiency and use of sleep medications) as predictors of ODI ($r^2 = 0.724$, $p < 0.001$). Pain is a known correlate to ODI and is a primary treatment target. **Conclusion:** We have shown that disordered sleep accounted for significant variation in ODI independent of pain. Research directed to understanding the relation between sleep and disability is required.

1.1.02

Agreement between back and/or leg pain dominance as reported by patients compared with the surgeon-reported primary indication for surgery: a preliminary study from the CSS surgical registry. ***Y. Raja Rampersaud,*† N. Manson,‡ E. Abraham,‡ O. Persaud,*† M. Mckeon,‡ C. Fisher.§*** **From the *Division of Orthopaedic and Neurosurgery, Department of Surgery, University of Toronto, the †Musculoskeletal Health and Arthritis Program and Krembil Neuroscience Program, Toronto Western Hospital, University Health Network, Toronto, Ont., ‡Spine Care, Sports Medicine, and Orthopaedic Surgery, Canada East Spine Centre and Horizon Health Network, Saint John, NB, and the §Spine Program, Vancouver Hospital, Vancouver, BC**

Background: Surgical outcomes in the lumbar spine tend to be more reliable for leg- compared with back-dominant pain. However, Wai and colleagues (2009) found that patients' ability to determine if their spine-related pain was back- and/or leg-dominant was unreliable. The primary objective of this study was to assess the agreement between patient-reported back- and/or leg-dominant pain and the surgeon's clinical indication for surgery. **Methods:** Baseline data from 456 patients enrolled in the CSS surgical registry were retrospectively assessed. The primary outcome measure was the agreement between patient-reported back- and/or leg-dominant pain and surgeon-stated indication for surgery. Univariate analysis was used to compare differences in demographic and surgical variables between those patients with and without agreement. **Results:** The percentage of patients who indicated back/leg/equal pain dominance using a self-reported visual analogue pain scale (VAS) was 26.5%/32.5%/41.0%. This is in contrast to the surgeon-stated indication for surgery (5.0%/71.5%/23.5%, respectively). Agreement between patient-reported back and/or leg pain dominance and surgeon-reported primary indication for surgery occurred 33.8% of the time. There was no difference between those patients with agreement and those without with regards to sex, age, BMI, pathology diagnosis (disc, spinal stenosis, degenerative spondylolisthesis), ethnicity, surgical procedure, number of surgical levels and primary or revision surgery. There was, however, significantly greater agreement in patients with a higher back pain score ($p < 0.0001$). **Conclusion:** There is a mismatch in what surgeons state as the primary clinical indication for surgery compared with the back versus leg pain dominance reported by patients. Patient-reported back and leg pain scores versus patient perception of the specific symptom(s) targeted by a proposed intervention is unclear and should be specifically documented during the consent process and also be reflected on research questionnaires.

1.1.03

Outcomes based on straight leg raise findings. ***G. McIntosh, H. Hall, T. Carter.*** **From the CBI Health Group, Toronto, Ont.**

Background: The straight leg raise (SLR) test is a common component of a clinician's low back pain (LBP) physical examination. This study compares the rehabilitation outcomes of those with (n = 343) and those without (n = 1853) a positive SLR test result. **Methods:** This was a prospective observational cohort study of patients with low back pain (n = 2196) treated nonoperatively at 40 spine care rehabilitation clinics across 4 provinces between January 2008 and June 2010. Positive SLR findings were cross referenced with location of dominant pain to distinguish false positives from true positives. Outcomes were calculated for 3 groups: false positives (positive SLR, back-dominant pain, n = 288), true positives (positive SLR, leg-dominant pain, n = 55) and true negatives (normal neurology, n = 1853). **Results:** The mean age of the cohort was 39.4 (SD 11.8, range 18–65) years, with 61.7% male. There was only a 16% true positive rate (55 of 343)

for SLR testing. Results by SLR status were as follows. The true positive group had significantly more female patients ($p < 0.02$) and had significantly more chronic pain than the other 2 groups ($p < 0.04$). The true positive group experienced significantly more pain, more medication use, treatment days and less functional improvement at treatment conclusion and at 3-month follow-up than the false positive and true negative groups ($p < 0.05$). For the false positive and true negative groups, there were no statistically significant differences in medication use and functional improvement at follow-up. There were no statistically significant differences in return to work rates between the 3 groups: true negative, 85.1%; true positive, 76.4%; false positives, 77.4%. **Conclusion:** A positive SLR was overdiagnosed; a true positive SLR test was a rare clinical finding. In spite of slower treatment response, higher medication use and less pain reduction in the true positive group, they had comparable rates of return to work.

1.2.04

Wait-time effects on spinal patients. ***Y. Raja Rampersaud, A. Fernandes, O. Persaud.*** **From the Division of Orthopaedic and Neurosurgery, Department of Surgery, University of Toronto, Toronto, and the Musculoskeletal Health and Arthritis Program and Krembil Neuroscience Program, Toronto Western Hospital, University Health Network, Toronto, Ont.**

Background: Wait times for surgical spine consultation are problematic. The potential for neurologic sequelae necessitates vigilant triage of spinal referrals. However, the variable natural history and inconsistent referral information often make triage a challenging process. The primary objective of this study was to determine which nonurgent degenerative spinal conditions typically worsen or improve during the wait for consultation. **Methods:** Patients ($n = 154$) with nonurgent spinal referrals were enrolled prospectively. Study questionnaires were completed within 1 month after referral and again at consultation. The primary outcome measures were patient-perceived symptom change and change in SF-36 score. Patient demographics and diagnosis, as well as nonsurgical health care utilization information were also collected. **Results:** The mean age and percentage of female participants in the overall population were 58.5 years and 56.5%, respectively. At consult, 31%, 39% and 29% of the overall population reported feeling better, worse or the same since referral (mean wait time 5.62 mo). When broken down by radiographic diagnosis of degenerative disc, herniation, spondylolisthesis and stenosis (mean wait time 8, 4, 6 and 6 mo, respectively), 43%, 46%, 16% and 15% felt they were better at consult than at referral; 36%, 26%, 28% and 37% felt there was no change; and 21%, 26%, 54% and 48% felt they were worse. When broken down by clinical diagnosis of back pain, radiculopathy, claudication and chronic pain (mean wait time 6, 4, 7 and 7 mo, respectively), 29%, 44%, 14% and 9% felt they were better at consult than at referral; 40%, 27%, 24% and 9% felt there was no change; and 31%, 28%, 59% and 82% felt they were worse. Changes in SF-36 score were in an appropriate direction with this subjective self-assessment; however, the changes were generally not clinically significant. Prior to referral, 2%, 13%, 23%, 12% and 49% of patients were using 0, 1, 2, 3 and 4 or more methods of treatment/healthcare for their spinal condition, respectively; during the referral to consult period there was no significant change in utilization. **Conclusion:** Surgical patients with degenerative spondylolisthesis/spinal stenosis are most likely to perceive symptom worsening while waiting for spinal consultation. Traditionally, owing to the mechanical/postural nature of their symptoms, these patients are also most likely to be triaged at an elective (low) priority. Improved advocacy for this growing patient population is required.

1.2.05

Understanding primary care physicians' challenges, barriers and priorities in caring for patients with low back pain. ***J. Alleyne,* B. Harvey,† J. Meuser,‡ Y. Raja Rampersaud.§*** **From *Sport C.A.R.E., Women's College Hospital, the †Dalla Lana School of Public Health, University of Toronto, the ‡Professional Development Program Department of Family and Community Medicine and the §Division of Orthopaedic and Neurosurgery, Department of Surgery, University of Toronto, and the Musculoskeletal Health and Arthritis Program and Krembil Neuroscience Program, Toronto Western Hospital, University Health Network, Toronto, Ont.**

Background: Although many low back pain (LBP) clinical practice guidelines (CPGs) exist, they often fall short in addressing the multifactorial challenges associated with the primary management of LBP (e.g., recurrent LBP or patient preference). The objective of this project was to develop a clearer understanding of the gaps, barriers and the primary care physicians' (PCP) priorities in the care of patients with LBP as well as an understanding of current practice trends. **Methods:** An independent research team at the Centre for Effective Practice performed a literature review, conducted a small focus group and a survey of family physicians ($n = 325$) across Ontario. The literature review was focused on specialist referral, factors influencing the decision to refer and implementation and evaluation of CPGs. The literature search results informed the interview guide for the focus group and the design of an Internet survey tool. All results were tabulated and underwent qualitative analysis. **Results:** Physicians reported that patients most often requested an imaging test, funded physiotherapy and a note for work activity restrictions. In general, PCPs are comfortable in assessing acute LBP; however, common barriers noted were lack of comfort in dealing with complex or recurrent LBP, occupational issues, pain management, and a lack of patient-friendly key messages and education and assessment tools. In addition, physicians also reported having education needs regarding the timing and clinical interpretation of imaging reports. The most common reasons PCPs referred to a spine surgeon were compression of neurologic structures reported on imaging, constant leg pain and/or altered sensation, and patient request for a second opinion. **Conclusion:** These findings indicate the need for development of broader scope, primary care–specific clinical education modules for physicians and patients that could be disseminated as clinical tools, a web-based repository of information and academic detailing by clinician experts.

1.2.06

Can a qualified nonphysician expert predict the usefulness of MRI scans in patients with back-related complaints? ***L. McLaughlin,* M. Ramonas,* C. Goldsmith,†***

B. Dunlop. **From *McMaster University, Hamilton, Ont., and †Simon Fraser University, Vancouver, BC**

Background: Wait times for MRIs for patients with back-related complaints are disturbingly long despite the common consensus that axial imaging is not required to diagnose or treat a majority of these problems. This wait often delays appropriate treatment. Many unhelpful MRI scan reports lead to unnecessary apprehension for referring doctors and their patients and frequently stimulate additional surgical consultation requests. This problem is aggravated by surgeons requiring axial imaging before scheduling consultation. Most spine surgeons appreciate that an expert interview and exam can identify those patients for whom axial imaging would be useful in diagnosis and treatment. **Hypothesis:** Advanced practice orthopedic physiotherapists with surgical screening training possess the skills in spine-specific interview and exam to identify those patients for whom axial imaging would be useful. **Methods:** To test this hypothesis, 75 patients from 3 separate clinical cohorts were evaluated. The physiotherapist and orthopedic surgeon independently predicted from the clinical interview and exam whether they believed that an MRI scan would be helpful in patient management. The level of agreement was calculated using chance corrected agreement or κ values. Subsequently, the completed MRI scans were reviewed to evaluate whether each prediction was correct. **Results:** Minimum κ values of 0.80 indicate near perfect agreement in the prediction of MRI usefulness, and review of the MRI scans themselves confirmed the predictive accuracy. **Conclusion:** A qualified, advanced practice orthopedic physiotherapist can accurately predict those back patients whose care would benefit from an MRI scan. Screening of patients with back-related complaints by these qualified nonphysician experts could reduce the number of patients undergoing unhelpful MRI scans, thereby helping to diminish the overall waits for appropriate care.

1.2.07

A pilot project to study the effects of conservative treatment for low back pain patients on a neurosurgical spine waitlist. *L. Fenerty,[*] S. Christie,[*†] M. Lynch.[‡]* From the Divisions of Neurosurgery, *Queen Elizabeth II Health Sciences Centre and †Dalhousie University, and the ‡Queen Elizabeth II Health Sciences Centre Pain Management Unit, Dalhousie University, Department of Psychiatry and Anesthesia, Halifax, NS

Background: Definitive diagnosis and treatments for low back pain (LBP) continue to elude practitioners across the spectrum of care. This study examined the effects of conservative treatment using an osteopathic approach for LBP patients awaiting neurosurgical consultation. **Methods:** Hospital ethical review and approval were obtained for the study. Patients with LBP on a neurosurgical spine wait list in an urban, university-affiliated teaching hospital were approached for consent. Sixteen patients were enrolled and randomized to either a control group, receiving telephone follow-up, or to a treatment group, receiving 3 osteopathic treatments. Pain and depression measures were administered to both groups at baseline and at 4 weeks follow-up. Data were examined for differences within participant groups and between treatment and control groups over the 2 measurement times. Repeated-measures analyses of variance were examined using SPSS. **Results:** Eight female and 8 male participants, with a mean age of 46.20 years, were randomized. The mean pain duration was 7.35 years, with all patients having tried previous conservative therapy. The mean BMI was 26.92, and 72% of patients were taking pain medications. There were statistically significant differences between groups over time detected on the pain visual analogue scale (VAS); the control group showed an increase in pain from 4.43 (baseline) to 5.14 (4 wk), and the treatment group had decreased pain from 4.17 (baseline) to 3.17 (4 wk; $p = 0.007$). A statistically significant interaction was also detected for the physical component summary score (PCS) of SF-36, showing a decrease in the control group from 37.76 (baseline) to 36.98 (4 wk) and an increase in the treatment group from 35.03 (baseline) to 40.78 (4 wk; $p = 0.03$). **Conclusion:** The treatment and control groups have behaved differently across time measures from pre- to postmeasurements for the VAS and the SF-36 (PCS). Further study is warranted for the consideration of conservative treatment with an osteopathic approach for patients with LBP.

1.3.08

Variations in patients and surgical management between 2 Canadian spine centres: a preliminary study from the Canadian Spine Society surgical registry. *Y. Raja Rampersaud,[*] N. Manson,[†] E. Abraham,[†] O. Persaud,[*] M. McKeon,[†] C. Fisher.[‡]* From the *Division of Orthopaedic and Neurosurgery, Department of Surgery, University of Toronto, and the Musculoskeletal Health and Arthritis Program and Krembil Neuroscience Program, Toronto Western Hospital, University Health Network, Toronto, Ont., †Spine, Sports Medicine, and Orthopaedic Surgery Canada East Spine Centre and Horizon Health Network, Saint John, NB, and the ‡Spine Program, Vancouver Hospital, Vancouver, BC

Background: The literature would indicate there is considerable regional variability in surgical decision-making in the United States. Whether this variability is present in a single-payer health system is not known. The purpose of this study was to assess regional variability among participating centres of the Canadian Spine Society spine registry (CSS-SR). **Methods:** Preliminary baseline data from patients enrolled at 2 sites from the CSS-SR were retrospectively compared: the University Health Network in Toronto (UHN, $n = 234$, 1 surgeon) and the St. John's Regional Hospital (SJRH, $n = 238$, 2 surgeons). These populations were categorized by diagnosis: disc pathology (DP), spondylolisthesis (SP) and stenosis (ST). Univariate analysis was used to compare differences in demographics, surgical data and baseline outcomes. **Results:** For DP, there was no difference in age, sex and Oswestry Disability Index (ODI) scores. The SJRH treated more surgical levels (1/2/3) than the UHN (43.3%/43.3%/13.5% v. 96.2%/3.8%/0%, respectively) and fused more patients (37.5% v. 8.9%; $p < 0.01$). For SP, there was no difference in BMI and sex. Patients at the SJRH were 9.3 years younger, had ODI scores that were on average 8.22 higher, had more surgical levels treated (1/2/3) than at UHN (46.7%/36.7%/16.7% v. 71.6%/21.6%/6.8%, respectively) and more patients fused (96.7% v. 71.6%; $p < 0.01$). For ST, there was no difference in age. The patient group at the SJRH had higher BMIs, more males, ODI scores that were on average 10.7 higher, had more surgical levels treated (1/2/3) than at UHN (29.6%/26.1%/44.3% v.

43.3%/36.7%/20.0%, respectively) and had more patients fused (79.6% v. 20.0%; $p < 0.01$). There was no difference in clinical indication for treatment for any diagnosis. **Conclusion:** Although limited by data from only 2 sites, the results of this study suggest that there will be significant regional variability within the CSS surgical registry. These findings may have important implications regarding future data collection, analysis and interpretation. The findings also suggest that a single-payer system may not influence surgical decision-making.

1.3.09

Assessment of the incremental cost–utility of surgery compared with failed medical management for the treatment of hip, knee and spine osteoarthritis. ***Y. Raja Rampersaud,*† P. Tso,‡ K. Walker,‡ B. Eagen,‡ S. Lewis,*† R. Gandhi,†§ R. Davey,†§ N. Mahomed,†§ P. Coyte.‡*** **From the *Divisions of Orthopaedic and Neurosurgery, Department of Surgery, University of Toronto, the †Musculoskeletal Health and Arthritis Program and Krembil Neuroscience Program, Toronto Western Hospital, University Health Network, the ‡Department of Health Policy, Evaluation and Management, Faculty of Medicine, University of Toronto, and the Institute for Clinical Evaluative Sciences, and the §Division of Orthopaedic Surgery, Department of Surgery, University of Toronto, Toronto, Ont.**

Background: The demand for surgery for osteoarthritis of the hip, knee and spine continues to rise. Whereas total hip arthroplasty (THA) and total knee arthroplasty (TKA) have been widely accepted as cost-effective procedures, spine surgeries — decompression and decompression with fusion — for the treatment of degenerative conditions remain underfunded owing to the inconsistency of effectiveness and cost-effectiveness studies in the scientific literature. **Methods:** An incremental cost–utility ratio (ICUR) analysis comparing decompression and decompression with fusion to THA and TKA, from a health system perspective, was based on an observational, matched-cohort study of prospectively collected outcomes and retrospectively collected costs. The primary outcome (ICUR = $/quality-adjusted life year [QALY]) was determined by using perioperative costs and Short Form-6D (SF-6D) utility scores. The SF-6D scores were collected preoperatively and annually over a 5-year follow-up period. Utility was modelled over the lifetime; quality-adjusted life years were determined. Surgical cost included total perioperative, in-patient rehabilitation and revision cost for each cohort over 5 years. Cost per QALY gained was calculated by estimating mean incremental (surgery compared with failed medical management) lifetime costs and QALYs for each diagnosis group after discounting costs and QALYs at 3%. Sensitivity analyses were conducted to determine factors affecting the value of each type of surgery. **Results:** The lifetime ICUR was $4091/QALY for THA, $5038/QALY for TKA and $3530/QALY for combined spine surgery groups (fusion was $7444/QALY, and decompression was $3530/QALY). Values are based on life expectancies of 20.4, 19.1 and 19.6 years for hip, knee and spine patients, respectively. The sensitivity analyses (outcome, cost, revision rate) did not alter the ranking of the lifetime ICURs. **Conclusion:** In patients with lumbar spinal stenosis for whom medical management has failed, the ICUR for spinal stenosis surgery is similar to those of THA and TKA for the treatment of osteoarthritis over the lifetime.

1.3.10

Cost-effectiveness analysis of a reduction in diagnostic imaging for the assessment of degenerative spinal disorders. ***J.S.M. Kim,* J.Z. Dong,* S. Brener,* P.C. Coyte,*† Y. Raja Rampersaud.‡*** **From the *Department of Health Policy, Evaluation and Management, Faculty of Medicine, University of Toronto, the †Institute for Clinical Evaluative Sciences, and the ‡Divisions of Orthopaedic and Neurosurgery, Department of Surgery, University of Toronto, and the Musculoskeletal Health and Arthritis Program and Krembil Neuroscience Program, Toronto Western Hospital, University Health Network, Toronto, Ont.**

Background: Advanced imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI) are highly sensitive but often nonspecific diagnostic tools. Despite this, CT and MRI are overused in the diagnosis of degenerative spinal disorder. From the Ministry of Health perspective, we evaluated against usual care the cost-effectiveness of a hypothetical triage program for nonemergent spinal disorders that may eliminate unnecessary CT and MRI scans. **Methods:** Diagnostic and surgical data were prospectively collected on 2046 outpatients who received consultation with the senior surgical author at an academic institution between September 2005 and April 2008. Using these data, we modelled an evidence-based diagnostic triage program wherein spine-focused clinical assessments and plain radiographs would be applied before ordering CT and MRI scans. Incremental costs were the incurred expenses from additional consultations and radiographs, less the cost savings from the eliminated CT and MRI scans. Outcomes were expressed as the number of surgical candidates identified per MRI used in diagnosis, reflecting the efficiency of diagnostic imaging. **Results:** The triage program incurred $115 034 from additional consultations and radiographs and saved $2 117 697 from eliminated CT and MRI scans, resulting in net savings of $2 002 663 for the 31 months of the study period or $775 224 per year. In usual care, 0.328~0.418 surgical candidates were identified per MRI, whereas in the triage program, 0.736~0.885 surgical candidates were identified per MRI, resulting in over a 2-fold improvement in MRI efficiency. The triage program was therefore dominating. Applying it to high-volume spine surgeons in Ontario, we estimated that the implementation of the triage program would save the province $24 171 159 per year. **Conclusion:** Eliminating unnecessary imaging in the diagnosis of spinal disorders can save significant healthcare resources.

1.4.11

Timing of surgery and radiotherapy in the management of metastatic spine disease: expert opinion. ***R. Lee, C. Fisher.*** **From the Vancouver General Hospital, Vancouver, BC**

Background: Radiotherapy has been the traditional treatment for metastatic disease of the spine, with the role of surgery limited to cases of neurologic deterioration during radiation and failure of radiation therapy. With appreciation for spinal instability as a valid indication for surgical stabilization, the understanding that radiotherapy and surgery should often be combined has reached maturity. There are, however, potential adverse events associated with radiation delivered in close proximity to surgery, especially complications related to wound healing. We have recently

published a systematic review of the literature to determine the optimal timing of surgery and radiotherapy in patients surgically treated for spinal metastases, suggesting that the time interval should be at least 1 week to minimize wound complications. However, the majority of the papers did not address the research question, and the dose of total radiation was not specified. Our purpose was to obtain expert opinion with regard to the timing of radiation and surgery for spinal metastases. This could then be combined with our systematic review in order to produce an evidence-based recommendation. **Methods:** This is an observational study. Questionnaires were sent to radiation oncologists and surgeons throughout BC, Toronto and several centres in the United States. Results were then be obtained by return of post or email. **Results:** A total of 84 responses were received from radiation oncologists, with another 25 from spinal tumour surgeons. There was good consensus between both groups: 41% recommended waiting 1 week before performing spine surgery after conventional radiation, whereas 42% recommended waiting 2 weeks before starting conventional radiation after uncomplicated spine surgery. A similar pattern was demonstrated with sterotactic surgery. **Conclusion:** This study adds to the recommendation that the optimal radiotherapy–surgery/surgery–radiotherapy time interval should be at least 1 week to minimize wound complications.

1.4.12

Application of a novel bipolar cooled radiofrequency probe in a porcine model, a treatment for metastatic vertebrae.

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Background: The spine is a common bony site of metastatic involvement. There are promising new therapies that may be useful adjuncts to complement existing local strategies, such as spinal surgery and radiation therapy. Radiofrequency (RF) therapy has proven to be clinically effective in creating necrosis in a local, minimally invasive and targeted manner. Its mechanism is by inducing frictional heating, which leads to tissue ablation. Cooled bipolar radiofrequency (CRF) is a substantial improvement to conventional radiofrequency whereby larger regions can be safely treated while protecting sensitive neighbouring tissues from thermal effects. We hypothesize that bipolar CRF represents a safe and effective therapeutic approach that can locally coagulate targeted cells within vertebrae without damage to the adjacent structures. Our purpose was to evaluate the safety zone and efficacy of bipolar CRF ablation within the healthy porcine vertebrae for the potential treatment of vertebral metastases. **Methods:** Treatment on appendicular soft tissue and bony tumour lesions in a preclinical rabbit model guided device development and optimized treatment parameters. Subsequently, a porcine model was used to scale up therapy to vertebrae approximating more clinically relevant dimensions. Pretreatment MRI was performed of porcine spine, and CRF was applied to animals under anesthesia. A CRF probe was placed through a transpedicular approach to targeted lumbar vertebrae with a sham control performed at a noncontiguous spinal level. Post-treatment neurologic evaluation as well as MR imaging and histology characterized the region of effect. **Results:** In treated porcine spines, there were no neurologic complications, and MRI confirmed an oval shaped ablative zone of 2 cm long alongside the probe tract. Thermocouple measurements external to targeted vertebrae indicated output values in the physiologic temperature range, suggesting that treatment was confined within targeted vertebrae and thus safe. **Conclusion:** Bipolar CRF offers the potential for a safe, minimally invasive, low-cost treatment for spinal metastases.

1.4.13

One year results of the first randomized trial comparing balloon kyphoplasty to nonsurgical management among cancer patients with vertebral compression fractures.

P. Jarzem,* R. Pflugmacher,† J. Berenson,‡ J. Zonder,§ J. Tillman,¶ T. Ashraf,¶ F. Vrionis.* **From *McGill University, Montréal, Que., the †Charite Universitätsmedizin Berlin, Berlin, Germany, the ‡Institute for Myeloma and Bone Cancer Research, West Hollywood, Calif., the §Myeloma Program, Karmanos Cancer Institute, Detroit, Mich., ¶Medtronic, Sunnyvale, Calif., and the **Neuro-Oncology Division, H. Lee Moffitt Cancer and Research Institute, Tampa, Fla.**

Background: We previously reported the 1-month results of a randomized trial of balloon kyphoplasty (BKP) and conservative care (NSM) for destructive vertebral lesions in cancer patients. Here we report the 1-year results of the same trial. **Methods:** Adult patients diagnosed with cancer and fewer than 3 painful vertebral compression fractures (VCFs) were randomly assigned to BKP ($n = 70$) or NSM ($n = 64$) and followed for 12 months. Crossover to BKP was allowed in the NSM arm at 1 month. **Results:** There was a significant improvement for BKP-treated patients of –8.3 points in their Roland Morris Disability Questionnaire (RMDQ) score, whereas the NSM group showed no significant change. At 1 week, BKP-treated patients also showed significant improvement in their back pain (–3.8 points), whereas patients treated with NSM had no significant change; similar changes from baseline scores were observed at 1 month for back pain. Patients who underwent BKP also reported fewer days of diminished activity owing to back pain (treatment effect 6.3 fewer days per 2 weeks, $p < 0.0001$) and greater improvements in quality of life as measured by the SF-36 physical component summary score (treatment effect 8.4 points higher, $p < 0.0001$). Thirty-eight of the 61 patients in the NSM group crossed over and underwent BKP. These crossover patients showed similar benefits in regards to back disability, back pain relief, analgesic use, activity level and quality of life as those originally assigned to BKP. Adverse events were similar between the 2 groups. This randomized study demonstrates that cancer patients with VCFs treated with BKP have a superior outcome compared with NSM as measured by the primary end point, the RMDQ score. Balloon kyphoplasty also resulted in a marked reduction in back pain, improved quality of life and fewer days with limitation of daily activities; these effects were maintained throughout the 12-month study period. **Conclusion:** This study supports the benefits of BKP in the management of cancer patients with VCFs.

1.4.14

Traditional open versus minimally invasive decompression and fusion of the lumbar spine: a retrospective

analysis. ***N. Manson,* M. McKeon,† E. Abraham.*** **From the *Horizon Health Authority, Saint John, NB, and †Memorial University, St. John's, NL**

Background: Minimally invasive surgical (MIS) techniques offer theoretical advantages over traditional midline (OPEN) techniques for lumbar decompression and fusion procedures. These advantages have yet to be adequately substantiated in the literature via direct comparison. Our purpose was to identify advantages and pitfalls of MIS versus OPEN techniques in the management of lumbar degenerative pathologies via decompression and fusion. **Methods:** We conducted a retrospective review of a prospective database from September 2006 to November 2009 and identified 187 patients who underwent single-level lumbar decompression and fusion procedures. Of these 187, 141 (90 OPEN, 51 MIS) met the inclusion criteria and were included in the analysis. Preoperative (i.e., patient demographics, disability and pain scores), intraoperative (i.e., blood loss, surgical time, complications) and postoperative (i.e., complications, revision rates, disability and pain scores) data were analyzed using an analysis of variance ($p < 0.05$) to detect significant differences between groups. **Results:** Both surgical groups demonstrated statistically similar preoperative demographics (age, sex, BMI, Oswestry Disability Index [ODI], visual analogue scale [VAS] leg and back). The OPEN procedure demonstrated statistically greater blood loss before (519.6 v. 259.4 mL) and after (377.5 v. 232.2 mL) Cell Saver blood return, with a significantly shorter operative time (124.1 v. 194.4 min). Otherwise, all other measures were similar. Intraoperative and postoperative complications, hospital stay and revision rates were equal. At 1-year follow-up, both groups displayed a similar drop in ODI score (OPEN 50.7% to 29.3%, MIS 55.7% to 39.6%), VAS leg (OPEN 7.4 to 4.3, MIS 7.3 to 4.1) and VAS back (OPEN 7.8 to 3.6, MIS 7.5 to 4.5). **Conclusion:** Specific surgical approach techniques may offer certain advantages to optimize outcomes. Ultimately, the appropriate technique at the level of the spine to provide decompression and stabilization should ultimately dictate surgical success. Future work should focus on preoperative decision-making, operative challenges and objective biomechanical measures to assure similarity between techniques.

FRIDAY, MARCH 11, 2011

2.1.15

Building a health progression model to evaluate long-term outcomes for people with a spinal cord injury. ***A. Barnes,* R. Lewis,* V. Noonan,† A. Santos,* D. Atkins,* A. Singh,‡ A. Burns,§ L. Soril,† M. Fehlings,‡ B. Sun,† J. Zhang,* S. Donald,* A. Cheung,† A. Townson,¶ R. Willms,¶ L. Belanger,** J. Batke,** J. Street,** B. Kwon,†** M. Dvorak.†**** **From the *Centre for Operations Excellence, Sauder School of Business, University of British Columbia, the †Rick Hansen Institute, Vancouver, BC, the ‡Krembil Neuroscience Centre, Spinal Program, Toronto Western Hospital, University Health Network, the §Division of Physiatry, Department of Medicine, University of Toronto, Toronto Rehabilitation Institute, Toronto, Ont., the ¶GF Strong Rehab Centre, Division of Physical Medicine and Rehabilitation, University of British Columbia, and the **Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, Vancouver, BC**

Background: Perhaps one of the least-understood metrics from studies evaluating health care delivery for persons with spinal cord injury (SCI) is the impact of specific interventions on their "rest of life." To understand how changes to the health care process affect long-term patient outcomes, a proof-of-concept health progression model (HPM) for SCI has been developed to simulate the lifetimes of persons with traumatic SCI upon discharge to the community. **Methods:** For each year of an individual's postinjury life, logistic regression models based on methods from the literature are used to predict secondary complications before estimates of readmissions and length of stay (LOS) are made. Results from a multivariable regression model of utility, collected from data from the Rick Hansen Spinal Cord Injury Registry (RHSCIR) are applied to generate a quality-adjusted life year (QALY) measure, based on the individual's characteristics and experiences in a given year. Finally, a Cox proportional hazards model drawn from the literature is applied with Canadian lifetable data to predict mortality. If a simulated individual is expected to survive a given year, the modelling process is repeated. **Results:** This model produces estimates of health-related and economic consequences of SCI, with lifetimes being simulated many times to generate long-term outcome measures such as quality-adjusted life expectancy, years experiencing secondary complications and health care costs. Preliminary HPM estimates demonstrated earlier-than-expected mortality, a consequence of high secondary complication rates. **Conclusion:** The HPM can be linked with the health care delivery model to provide a greater understanding of the consequences of interventions relating to SCI care. For example, early complications such as a respiratory infection or pressure sore will have life-long consequences, and their economic and personal impact can be measured using this model. This form of modelling can provide compelling business cases for clinicians to advocate for best clinical practice.

2.1.16

Building a discrete event simulation model to assess and investigate the system of care in British Columbia for SCI patients. ***J. Gurling,* A. Santos,* R. Lewis,* V. Noonan,† D. Atkins,* L. Soril,† A. Singh,‡ M. Fehlings,‡ A. Burns,§ B. Sun,† S. Donald,* A. Townson,¶ R. Willms,¶ L. Belanger,** J. Batke,** J. Street,** B. Kwon,†** M. Dvorak.†**** **From the *Centre for Operations Excellence, Sauder School of Business, University of British Columbia, the †Rick Hansen Institute, Vancouver, BC, the ‡Krembil Neuroscience Centre, Spinal Program, Toronto Western Hospital, University Health Network, the §Division of Physiatry, Department of Medicine, University of Toronto, Toronto Rehabilitation Institute, Toronto, Ont., the ¶GF Strong Rehab Centre, Division of Physical Medicine and Rehabilitation, and the **Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, Vancouver, BC**

Background: To optimize the access to care and patient flow for individuals with spinal cord injury (SCI), factors that may govern the performance of health care delivery across the continuum of care must be empirically evaluated. The objective

of this study is to develop a model of the prehospital, acute and rehabilitation services in British Columbia for people with traumatic SCI, in order to evaluate the timeliness and location of care and how they relate to outcomes. **Methods:** Discrete event simulation (DES) was used to model patients' journeys from the time of injury through acute care at Vancouver General Hospital and rehabilitation at the GF Strong Centre. Statistical analyses, including use of decision trees, regression modelling and data fitting to statistical distributions, were an extensive part of the DES development. The model has been designed to primarily use results from the analysis of data from the Rick Hansen Spinal Cord Injury Registry and to integrate information from the literature and the opinion of subject-matter experts. **Results:** This study has yielded a DES model that can perform policy analysis for the care of traumatic SCI patients in BC. The benefits of performing policy analyses are not only to measure and weigh the impact of changes to the system, but also to improve clinicians' understanding of the continuum of care and how decisions affect the experience and outcomes of patients. **Conclusion:** This DES model has been used to analyze system-wide impacts of policy and best practice initiatives. Results demonstrate how policy at one point in the continuum will have dramatic influences both upstream and downstream. Examples of resource reallocation are produced and will be described. This method of operations research is critical to improve both patient-related outcomes (health-related quality of life and reduction in complications) and system-wide impacts (costs and lengths of stay).

2.1.17

The incidence and prevalence of traumatic spinal cord injury in Canada. ***V. Noonan,*[*] *A. Farry,*[†] *D. Baxter,*[‡] *A. Singh,*[†§] *M. Fehlings,*[†§] *L. Soril,*[†] *B. Kwon,*[†¶] *M. Dvorak.*[†¶] **From the *University of British Columbia, the †Rick Hansen Institute, ‡Urban Futures, Vancouver, BC, the §Krembil Neuroscience Centre, Spinal Program, Toronto Western Hospital, University Health Network, University of Toronto, Toronto, Ont., and the ¶Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, Vancouver, BC**

Background: Measures of the incidence and prevalence of traumatic spinal cord injury (tSCI) in Canada are lacking. This information is crucial to inform research and policy regarding effective methods of SCI prevention and treatment. The purpose of this study was to estimate the initial incidence (number at time of injury), discharge incidence (number of cases following initial hospitalization) and overall prevalence of tSCI in Canada using the best available evidence. **Methods:** A systematic search of the literature from 2000 to 2010 was performed to identify studies reporting Canadian SCI incidence and prevalence statistics. A population-based study reporting estimates of SCI incidence and prevalence for Alberta was selected since it had the largest sample size, included multiple sources of data and removed duplicate cases. The initial incidence of tSCI was calculated to determine the number of persons with tSCI who die before or while in hospital. Prevalence was estimated by applying the discharge incidence rate to Canadian population statistics for mortality and birth rates, by single years of age and sex for each year between 1921 and 2010. To accurately reflect tSCI prevalence, age-specific mortality rates for tetraplegia and paraplegia were used. **Results:** The estimated initial incidence of tSCI is 1785 per year, and the discharge incidence is 1389. In 2010, it is estimated there are 43 974 (19 232 paraplegia, 24 742 tetraplegia) people living with tSCI in Canada. Between 2010 and 2030, the incidence and prevalence of SCI is projected to increase owing to an aging population. The prevalence of individuals with tSCI is expected to be 58 000 by 2030 (32% increase). **Conclusion:** This study provides current and future estimates of the incidence and prevalence of tSCI in Canada based on current evidence. More population-based studies are needed and national patient registries such as the Rick Hansen Spinal Cord Injury Registry will further validate these estimates.

2.2.18

Bladder dysfunction in patients with thoracolumbar spinal cord injuries: a long-term follow-up study. ***V. Noonan,*[*†] *S. Elliot,*[‡] *A. Aludino,*[*] *H. Zhang,*[*§] *M. Dvorak.*[†¶] **From the *Division of Spine, Department of Orthopaedics, University of British Columbia, the †Rick Hansen Institute, ‡GF Strong Rehabilitation Canada, the §Department of Statistics, and the ¶Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, Vancouver, BC**

Background: Patients with traumatic thoracolumbar (T11–L3) spinal cord injuries (T/L-SCI) report that bladder dysfunction impacts their quality of life. Correlating clinical outcomes to neuroanatomic injury in these patients is difficult since most authors assume the conus ends at L1 (vertebral level), but there is variability among individuals. Magnetic resonance imaging provides a more accurate estimate of the neural–axis level of injury and could differentiate the clinical characteristics of cord, conus and cauda equina injuries. The objective of this study was to examine bladder dysfunction in patients with T/L-SCI where MRI was used to classify the injury type. **Methods:** A cross-sectional follow-up study was conducted on patients admitted to an acute centre between 1995 and 2005 with a T/L-SCI. Magnetic resonance imaging was used to classify the injury type, and a neurologic exam was conducted at follow-up. Bladder dysfunction (e.g., incontinence, urine infections) was assessed using the Qualiveen patient-reported measure. A univariate, nonparametric analysis was used to examine the association of personal factors (age, sex, marital status) and injury type (cord, conus, cauda equina) with the Qualiveen specific impact of urinary problems (QSIUP) index (score range 0–4). **Results:** Fifty-one patients completed the follow-up; 82% of patients were male, and the median age at injury was 33 years. Injury types included cord (37%), conus (39%) and cauda equina (24%); 41% were complete injuries (AIS A) on follow-up. The median QSIUP index was 1.2 (range 0.0–3.8). Injury type, age and marital status had no effect on the QSIUP index. Women had a significantly higher QSIUP index ($p < 0.01$) compared with men, indicating greater bladder dysfunction. **Conclusion:** Women with T/L-SCI reported greater bladder dysfunction compared with men, which is consistent with previous studies. Bladder dysfunction was present in this population and did not appear to differ in severity between the various neuroanatomic levels of injury. Future studies should continue to define the clinical characteristics of T/L-SCI.

2.2.19

Best evidence in patient outcomes and clinician expectations regarding cervical spine trauma: What should we be telling patients? ***Peter Lewkonia, Christian DiPaola, Hongbin Zhang, Marcel Dvorak, Charles Fisher.*** **From the Combined Neurosurgical and Orthopaedic Spine Program, University of British Columbia, Vancouver, BC**

Background: Cervical spine injuries with no neurologic deficit form a substantial patient population in a spine surgeon's practice. Our previous work has demonstrated that there is substantial variability in what surgeons tell patients regarding outcomes of these injuries, thus patient expectations will differ and outcomes vary. To reduce variability, a systematic approach to providing guidelines to patients at the time of injury is needed and is the purpose of the study. **Methods:** Four common cervical spine injuries (Jefferson and Hangman's fractures, odontoid fracture and unilateral facet fracture) were used. Various outcome data including length of stay, activity level, return to work and range of motion were collected from a surgeon survey. Means for numerical values and modes for categorical answers from the survey data were combined with available data from a systematic review of the same injuries to create consensus evidence-based medicine guidelines. **Results:** Published outcome data were available for most injuries, especially facet and odontoid fractures. Using consensus expert opinion and the literature, answers to each question were achieved. For example, in Jefferson fractures, 35% of patients experience persistent neck or scalp pain, and SF-36 physical component summary scores average 10 points lower than normative values. No studies have assessed return to manual or labour work, but expert consensus recommended 5 months. **Conclusion:** Cervical spine injury may lead to both short- and long-term disability, even with optimal treatment. Outcomes have been poorly understood by surgeons and other providers along the care path. This variability in combination with a patient's preconceived notions of a neck injury lead to varied expectations and potentially inferior outcomes. By overcoming gaps in the literature with consensus expert opinion, our study provides surgeons and others with evidence-based medicine guidelines. This information can be presented to patients to frame expectations of typical outcomes during treatment.

2.2.20

The impact of patient expectations on outcome following treatment for spinal trauma. Part 2: What is the functional prognosis of thoracolumbar injuries? ***Rowan Schouten, Vanessa Noonan, Hongbin Zhang, Marcel Dvorak, Charles Fisher.*** **From the Combined Neurosurgical and Orthopaedic Spine Program (CNOSP), Vancouver, BC**

Background: This is a synthesis of systematic review and consensus expert opinion. Our aim was to determine evidence-based medicine guidelines on functional outcomes following common thoracolumbar injuries. The initial phase of a 4-part study assessed responses of the Spine Trauma Study Group to a series of common trauma scenarios. Results demonstrated substantial variability in the information conveyed to patients about their expected functional outcome. Spine trauma is generally perceived as a life-altering injury that causes substantial impairment; therefore, it is critical that patients get accurate answers to fundamental questions about functional and health-related quality of life prognosis. **Methods:** Four common thoracolumbar injuries (operative and nonoperatively treated burst fractures, flexion distraction injuries and vertebral compression fractures) were used. Residual pain, range of motion and restriction in social and recreational activities 1 year following injury and return to work were outcomes determined from a survey completed by 30 surgeons with spine trauma expertise. Answers from the survey were combined with available data from a systematic review of the same injuries and outcomes to create consensus, evidence-based medicine guidelines. **Results:** Published outcome data were available for most injuries, but not all outcomes. For 1 year following a thoracolumbar flexion distraction injury, 50% (range 37%–58%) of patients are pain free, 45% (range 0%–90%) have regained their preinjury range of motion and 85% (range 65%–96%) will rate their recreational and work activities as unlimited. Expected time to re-employment is 9–16 weeks. Length of hospital stay averages 5 days. Results for the other trauma scenarios are included. **Conclusion:** This combination of literature and expert opinion represents the best available evidence on functional prognosis after thoracolumbar trauma. By providing consistent, accurate information, surgeons and other care path providers will help patients develop realistic expectations, which may shape and improve their ultimate outcome.

2.2.21

Long-term health-related quality of life outcomes following thoracic fractures. ***R. Schouten,* O. Keynan,† H. Zhang,* M. Dvorak,* C. Fisher.**** **From the *Combined Neurosurgical and Orthopaedic Spine Program, Vancouver, BC, and the †Tel Aviv University, Tel Aviv, Israel**

Background: This is an ambispective cohort study with cross-sectional outcome assessment. Our aim was to describe and identify predictors of long-term health-related quality of life (HRQOL) outcomes following thoracic fractures (T2–T10). Although there is a body of literature on thoracolumbar injuries, no studies to date have assessed validated generic and disease-specific HRQOL outcomes following thoracic fractures. **Methods:** A prospectively collected fully relational spine database was searched to identify all adult patients treated between 1995 and 2008 with traumatic thoracic (T1–T10) fractures with and without neurologic deficit. The Short Form (SF)-36, SF-36 pain index, Oswestry Disability Index (ODI) and Prolo Economic Scale outcome instruments were completed at a minimum follow-up of 12 months. Preoperative and minimum 1-year postoperative radiographs were evaluated for alignment. A Spearman correlation univariate and multivariate regression analysis was used to identify predictors of the above outcomes from a range of demographic, injury, treatment and radiographic variables. **Results:** In total, 142 patients, mean age 35 (SD 14.2) years, were assessed at a mean follow-up of 62 (SD 26) months. Operative management was performed in 69%. The ODI and SF-36 physical component summary score (PCS) suggest ongoing functional impairment compared with normative population controls: 64% had returned to employment, 34% to their previous job. Using univariate analysis, nonoperative treatment was associated with a superior SF-36 PCS. The American Spinal Injury Association (ASIA) motor scores were negatively correlated with functional outcomes (SF-36 PCS, Prolo

Economic Scale, SF-36 pain index). Degree of kyphosis at final follow-up, adverse events and associated injuries were not correlated with poorer outcomes. **Conclusion:** Long-term follow-up of thoracic fractures indicate that generic and disease-specific HRQOL outcomes do not return to levels seen in a normative population control.

2.3.22

A population-based study of spine injuries on Saskatchewan farms. ***Gillian Paton, Daryl Fourney*. From the Division of Neurosurgery, University of Saskatchewan, Saskatoon, Sask.**

Background: With over 44 000 individual farms, farm dwellers account for 11% of the population of Saskatchewan. Spine injuries may cause significant disability, impair the ability to farm and increase stress on farm families. There is a lack of published data on spine injuries acquired on farms. The objective of this study was to determine the epidemiology of spine injuries on Saskatchewan farms to assist the further development of injury-prevention initiatives. **Methods:** Using the Canadian Centre for Agricultural Health and Safety's Saskatchewan Farm Injury Surveillance Database, all hospitalized farm-related spine injuries (including spinal cord injury, vertebral column fracture and vertebral dislocation) occurring in the 1990/91–2006/07 fiscal years were examined. Epidemiological factors examined included information about the patient, the circumstances of the accident and the health care delivered. **Results:** The registry captured 228 spine injuries on Saskatchewan farms between 1990 and 2007, including 15 spinal cord injuries. The majority (84.2%) of those injured were male, with the highest risk group aged 50–59 years representing 24.1% of the injuries. The most common cause of injury was falling from a height or machinery (41.2%). Over 45% of all machine-related injuries involved tractors. All patients were hospitalized for over 24 hours, with 44.7% spending over 1 week in hospital. Out of 13 health regions, between 7.0% and 12.7% of accidents occurred in each of 10 health regions, with no accidents occurring in the 3 northernmost regions. The highest rates of injury were seen in May, September and October (13.2%, 14.9% and 11.8%, respectively). **Conclusion:** Many patients hospitalized owing to farm-related spine injuries required prolonged stays. Injury-prevention initiatives should be targeted toward men aged 50–59 years residing in the southern areas of the province, with increased awareness of the dangers of falls and operating tractors.

2.3.23

Qualitative and quantitative assessment of soft tissue damage in the cervical spine following a unilateral facet injury. ***M. Nadeau,[*] S. McLachlin,[†] S. Bailey,[*] K. Gurr,[*] C. Bailey,[*] C. Dunning.[†] From the *London Health Science Centre and the †University of Western Ontario, London, Ont.**

Background: Despite the relatively common occurrence of unilateral facet injuries, guidelines to direct treatment have not been clearly established. This is partially because the literature is lacking biomechanical studies that quantify the associated instability or specify the anatomic disruption. This study developed an experimental method that reliably produced an impending unilateral facet dislocation (perched facet) in cadaveric spines. Postinjury mechanical testing and specimen dissection allowed for identification of the soft tissue damage and analysis of their associated instabilities. **Methods:** Nine fresh-frozen spine motion segments (C4–5 or C6–7) were mounted in a spinal loading simulator and digitized with an optical tracking system. Stability testing in flexion–extension, lateral bending and axial rotation was performed before and after a perched unilateral facet injury was induced. Pre- and postinjury range of motion (ROM) and neutral zone (NZ) for each motion were analyzed using paired *t* tests. Systematic inspection and dissection were then performed to define the soft tissue injury pattern. **Results:** A perched facet was achieved in all specimens. Range of motion and NZ increased following the subluxation; the largest increase was contralateral axial rotation. Postinjury dissections revealed bilateral capsular tears, greater than 50% disc disruption and at least 50% of the ligamentum flavum torn in 8 of 9 specimens, respectively. The interspinous and supraspinous ligaments were never completely disrupted, but were stretched in almost half of the specimens. The anterior and posterior longitudinal ligaments were spared in all but 1 specimen. **Conclusion:** This study demonstrates that the facet capsules, annulus/nucleus pulposus and ligamentum flavum are important cervical spine stabilizers. Significant discoligamentous injury occurs following a perched unilateral facet injury, resulting in increases in ROM and NZ. Treatment for unilateral facet dislocation should consider the extent of this discoligamentous involvement and primarily prevent rotation as the main instability.

2.3.24

Incidence and impact of adverse events in patients with traumatic SCI during acute care. ***J. Street,[*] V. Noonan,[†‡] B. Kwon,[*†] C. Fisher,[*] S. Paquette,[*] M. Boyd,[*] A. Cheung,[†] B. Sun,[†] L. Cartar,[†] M. Dvorak.[*†] From the *Vancouver General Hospital, Division of Spine, Department of Orthopaedics, University of British Columbia, the †Rick Hansen Institute and the ‡University of British Columbia, Vancouver, BC**

Background: Adverse events are common in patients with traumatic spinal cord injury (tSCI) and result in significant morbidity. The purpose of this study was to determine the incidence and types of adverse events occurring in patients with tSCI during acute care and the impact on length of stay (LOS) and health status. **Methods:** Patients with a tSCI discharged from Vancouver General Hospital between 2008 and 2009 were identified using the Rick Hansen SCI Registry (RHSCIR). Data on intra-, pre- and postoperative adverse events were prospectively collected using the Spinal Adverse Events Severity form. Data related to patients' injury, diagnoses, hospital admission and 1-year Short Form (SF)-36 physical and mental component summary scores were obtained from the Vancouver RHSCIR database. Multivariate analyses were performed to determine whether patient characteristics were associated with number and type of adverse events experienced, and whether these were associated with LOS and health status (SF-36) at 1-year postinjury. **Results:** In total, 104 patients with tSCI were included: 81.7% were male, and the mean age at injury was 43.9 (SD 18.5) years. Adverse events occurred in 83.6% of patients; 18.3% experienced an intraoperative adverse event and 78.9% experienced a pre-/postoperative event. The most frequent pre-/postoperative events were pneumonia (33.6%), urinary tract infections (UTIs; 31.7%), postoperative

neuropathic pain (22.1%), pressure sores (19.2%) and delirium (15.4%). Length of stay was significantly impacted by pressure sores, delirium, pneumonias and UTIs ($p < 0.01$), with LOS increasing by a multiple of 1.2 (UTIs) to 2.2 (pressure sores) compared with patients without the adverse event. There was no impact on health status at 1 year postinjury. **Conclusion:** Over 83% of patients with a tSCI sustain an adverse event during acute admission, which is higher than previously reported. Adverse events such as pressure sores and delirium result in significant costs to the health care system, and there is a need to prospectively monitor and prevent them.

2.4.25

Spinal cord injury induced neuropathic pain can be prevented in a murine model by early treatment with pregabalin. *Jason Meisner, Christine Short, Sean Christie, Dan Marsh*. From Dalhousie University, Halifax, NS

Background: Below-lesion neuropathic pain (NEP) is a frequent outcome of spinal cord injury (SCI) and is often refractory to treatment. Thus, it is of great interest to develop preemptive strategies to abrogate the development of NEP. The gabapentinoid agent pregabalin (PGB) is efficacious in established post-SCI NEP and has promising pharmacodynamic properties for use as a preemptive agent against the development of NEP. **Methods:** Using a mouse model of post-SCI NEP, animals were treated with PGB (10 mg/kg twice daily v. saline) acutely following injury, and daily for 2 weeks. **Results:** Animals did not demonstrate mechanical allodynia when tested up to 6 weeks following injury. A limited therapeutic window for treatment effect was observed, as development of allodynia was not blocked if this treatment schedule began 1 week postinjury. These results suggest maladaptive plasticity occurring in the 1-week interval following spinal cord injury is necessary for the development of NEP. Locomotor recovery, an indicator of adaptive plasticity, did not appear to be impaired by PGB treatment as measured by rotorod performance or Tarlov scores. Below-lesion expression of the PGB-binding target Cav $\alpha_2\delta_1$ was not altered by SCI or PGB treatment. Increased expression of the synaptogenic $\alpha_2\delta_1$ ligand thrombospondin was observed transiently following SCI. As PGB acts as a noncompetitive antagonist to interaction between thrombospondin and $\alpha_2\delta_1$, markers of excitatory synaptogenesis were evaluated to determine if the effect of PGB was mediated by an inhibition of excitatory synaptogenesis. **Conclusion:** These observations suggest that early, chronic treatment with PGB may be a safe and effective treatment with a long-lasting effect of preventing the development of mechanical allodynia after SCI.

2.4.27

Role of intraoperative betadine irrigation in decreasing postoperative wound infections in lumbar and lumbosacral instrumented fusions: a retrospective review. *A. Soroceanu,* E. Abraham,† N. Manson,† N. Attabib.†* From the *Queen Elizabeth II Health Sciences Centre, Dalhousie University, Halifax, NS, and the †Saint John Regional Hospital, Saint John, NB

Background: Eliminating postoperative infections is a priority in spine surgery, as this complication significantly increases the morbidity and cost of surgical interventions. This single-centre case series, intended as a pilot project, aims to examine the role of intraoperative betadine irrigation in decreasing the incidence of postoperative wound infections in lumbar and lumbosacral instrumented fusions. **Methods:** We performed a retrospective review on a consecutive series of patients who underwent instrumented fusion between January 2009 and May 2010. In our department, routine irrigation is performed using a 3% betadine solution or saline at the discretion of the surgeon. Data were obtained from a local database in which the authors' patients are enrolled. Univariate tests were performed to look at the distribution of infection risk factors between the 2 groups. Factors with $p > 0.2$ were considered confounders and were included in the multivariate analysis. The effect of betadine irrigation on infection was examined using multivariate logistic regression. **Results:** A total of 154 patients were reviewed (saline $n = 82$, betadine $n = 72$). The groups were similar with respect to age, sex, cancer, diabetes, smoking and steroid use. They differed in regards to obesity (saline 14.6%, betadine 27.7%; $p = 0.04$) and number of levels fused (saline 4.68, betadine 3.69; $p = 0.12$). After adjusting for these factors, logistic regression showed that the betadine group was associated with a trend toward decreased postoperative infection (OR 0.2118, $p = 0.064$). **Conclusion:** Limitations of this study include it being retrospective and its lack of randomization and power. Despite these limitations, our study showed that intraoperative betadine irrigation may play a role in decreasing postoperative infection rates in spine patients. This highlights the need for a larger, more powered, prospective randomized study that would allow us to further define the role of betadine in relation to infection prevention, and determine which patients may benefit more from its intraoperative use.

2.4.28

The effect of surgery on health related quality of life and functional outcome in patients with metastatic epidural spinal cord compression- initial results of the AOSpine North America Prospective Multicentre Study. *M. Fehlings,* B. Kopjar,† A. Vaccaro,‡ P. Arnold,§ C. Fisher,¶ Z. Gokaslan, J. Schuster,†† M. Dekutoski,‡‡ J. Finkelstein,§§ L. Rhines.¶¶* From the *University of Toronto, Toronto, Ont., the †University of Washington, Seattle, Wash., the ‡Thomas Jefferson University, Philadelphia, Pa., the §University of Kansas, Kansas City, Ks., the ¶University of British Columbia, Vancouver, BC, the **John Hopkins University, Baltimore, Md., the ††Hospital of the University of Pennsylvania, Philadelphia, Pa., the ‡‡Mayo Clinic, Rochester, Mn., the §§Sunnybrook Health Sciences Centre, Toronto, Ont., and the ¶¶University of Texas (MD Anderson), Houston, Tex.**

Background: Metastatic epidural spinal cord compression (MESCC) is common, and recent studies have provided evidence that in selected patients combined surgery and radiotherapy provides the optimal neurologic recovery. However, patients with MESCC have a relatively short life expectancy and face numerous challenges. Hence, the impact of surgery on improving quality of life outcomes in the setting of MESCC is less clear. **Methods:** In total, 72 surgical patients were enrolled in a prospective multicentre, cohort study involving 8 sites in North America. Outcomes were assessed using the pain assessments, American Spinal Injury Association (ASIA) scale, SF-36v2 and

EQ-5D. **Results:** The average age of patients was 58 (SD 11) years and 65% were male. Common primary sites were lungs (32%), prostate (15%), breast (11%) and kidney (11%). The baseline scores were as follows: EQ-5D was 0.38; SF-36 physical component summary 32; SF- 36 mental component summary 39, visual analogue scale (VAS), pain 6.1; and ASIA impairment grades at baseline were 35% E, 45% D, 14% C, 3% B and 3% A. Median survival was 157 days: 93% survived 1 month, 62% survived 3 months, 41% survived 9 months and 32% survived 12 months. Among the surviving patients, the average improvement at 3 months was for 0.23 on the EQ-5D ($p < 0.001$); 26 on the Oswestry Disability Index (ODI; $p < 0.001$); and 2.6 on the VAS, pain ($p < 0.05$). Also, there was a significant improvement in ASIA impairment grade ($p < 0.05$). There was no significant change in SF-36 physical and mental component summary scores. The gains in EQ-5D, ODI and VAS, pain, were maintained in patients who survived 6 months. **Conclusion:** Surgically treated patients with MESCC have poor survival. Among the surviving patients, the surgical treatment is associated with improvement in symptoms and functional outcomes. However, this does not translate into significant gains in overall health-related quality of life. Individuals with less than 3-month life expectancy may be less than ideal candidates for surgical intervention. Further follow-up and a larger sample size in this ongoing study will help to identify subgroups of patients who may benefit from the surgical intervention.

Saturday, March 12, 2011

3.1.29

Electrical stimulation in spine fusion: a meta-analysis of randomized controlled trials. ***C. Goldstein, B. Petrisor, B. Drew, M. Bhandari.*** **From McMaster University, Hamilton, Ont.**

Background: A substantial proportion of spine fusion operations result in nonunion. Electromagnetic stimulation is a method used to promote spine fusion, although its efficacy in this regard remains uncertain. The purpose of this systematic review and meta-analysis is to evaluate the effect of electromagnetic stimulation on spine fusion. **Methods:** Five electronic databases (MEDLINE, EMBASE, CINAHL, PubMed and the Cochrane Central Register of Controlled Trials) were searched from database inception to July 2009 for randomized controlled trials of electrical stimulation and spinal fusion. We also performed a hand search of 4 relevant journals from January 2000 to July 2009, the online proceedings of the North American Spine Society Annual Meeting from 2002 to 2008 and bibliographies of eligible trials. Trials randomizing adult patients undergoing spine fusion to active treatment with direct current, capacitance coupled or pulsed electromagnetic field stimulation or placebo and reporting on fusion rates were included. Two independent reviewers extracted data regarding clinical outcomes, treatment regimen and methodologic quality. **Results:** Of 1650 studies identified, 7 met the inclusion criteria. Electromagnetic stimulation in lumbar fusion was evaluated in 5 studies, and 2 addressed cervical fusions. Electromagnetic stimulation in lumbar spine fusion resulted in a significant decrease in the risk of nonunion (relative risk 0.60, 95% confidence interval 0.38–0.93, $p = 0.02$, $I^2 = 57\%$). Owing to limited and conflicting trials, similar effects were not observed in the 2 studies evaluating cervical fusion rates (relative risk 0.85, 95% confidence interval 0.29–2.53, $p = 0.77$, $I^2 = 56\%$). **Conclusion:** Pooled analysis shows a 40% reduction in the risk of nonunion of lumbar spine fusions with the use of electromagnetic stimulation, although a similar effect was not observed for fusions of the cervical spine.

3.1.30

A prospective randomized clinical trial of posterolateral lumbosacral spinal fusion with BMP-2 and titanium pedicle screw instrumentation versus BMP-2 alone: 2-year follow-up. ***W. Oxner, D. Alexander, A. Soroceanu, D. Shakespeare.*** **From Dalhousie University and the Queen Elizabeth II Health Sciences Centre, Halifax, NS**

Background: Bone morphogenic protein (BMP-2) is used in spinal arthrodesis to induce bone growth. Studies have demonstrated that it achieves similar fusion rates to iliac crest bone graft when used in instrumented fusions. Our study aims to evaluate the requirement for instrumentation in 1- and 2-level spinal arthrodeses when BMP-2 is used in conjunction with local bone to achieve fusion. **Methods:** In total, 50 patients were recruited and randomized to instrumented versus noninstrumented spinal arthrodesis. BMP-2 with local autologous bone was used in all patients. Patients were evaluated at 3, 6, 12 and 24 months postoperatively with questionnaires to assess clinical outcome (Oswestry Disability Index [ODI], visual analogue scale [VAS] and SF-36) and posteroanterior and lateral radiographs of the spine to assess radiographic fusion (Lenke score). At 24 months, a thin-cut (1-mm) CT scan was performed. **Results:** Two-year data are available on 40 patients. There were no statistically significant differences between the 2 groups based on the clinical outcomes measured. The mean ODI score was 22.5 (SD 5.1) for the instrumented group and 13.73 (SD 3.57) for the noninstrumented group ($p = 0.2$). The mean VAS for the instrumented group was 2.11 (SD 0.61) and 1.53 (SD 0.61) for the noninstrumented group ($p = 0.49$). The mean SF-36 (physical) score was 62.31 (SD 6.71) for the instrumented group and 54.66 (SD 5.43) for the study group ($p = 0.8$). The mean operating time was 105.8 (SD 5.91) minutes for the instrumented group and 88.6 (SD 3.61) minutes for the noninstrumented group ($p = 0.01$). Mean blood loss was 339.1 (SD 39.38) mL for the instrumented group and 273.1 (SD 33.8) mL for the noninstrumented group ($p = 0.1$). Preliminary radiographic analysis showed similar fusion rates for the 2 groups. Two-year follow-up on all patients will be completed by February 2010. Final clinical and radiographic data analysis will be presented at the meeting. **Conclusion:** BMP-2 and local bone graft demonstrated functionally equivalent clinical outcomes when used with or without instrumentation in lumbar spinal fusions while offering potential reduction in operative time and blood loss.

3.1.31

First human experience with a synthetic BMP-2 fragment: the preliminary results of a randomized, blinded controlled Canadian study. ***P. Jarzem,* D. Alexander,† W. Oxner,† S. Du Plessis,‡ A. Yee.§*** **From *McGill University, Montréal, Que., †Dalhousie University, Halifax, NS, the ‡University of Calgary, Calgary, Alta., and the §University of Toronto, Toronto, Ont.**

Background: Prefix (B2a molecule) is a 42–amino acid synthetic active fragment of the BMP-2 molecule. Prefix has proven efficacy in lower mammals and may have an improved safety profile compared with other BMPs. In order to evaluate the safety and efficacy of this new protein in humans, a pilot study has been carried out in Canada and the United States using Prefix for interbody fusion in patients with degenerative conditions of the spine. This study reports the 1-year data on only the Canadian patients. **Methods:** In total, 22 patients were enrolled from 2009 to 2010 at 5 Canadian sites. Patients were blindly randomized to either autograft, Prefix 150 mmg or 750 mmg used to create a transforaminal lumbar interbody fusion (TLIF). Outcome measures included Oswestry Disability Index (ODI) function and fusion outcome as assessed by CT and flexion–extension radiographs (independent blinded radiologist). **Results:** Regarding function, there was no statistically significant difference in the proportion of patients who improved at least 15 points on the ODI between all 3 groups at 1.5, 3, 6 and 12 months. The net change in ODI was the same among the 3 groups and was 25 points at 1.5 months and 30 points better at 3–12 months. Regarding fusion, there were no differences in the proportion of patients fused at any time. At 6 months, 3 of 5 autograft patients were fused, 1 of 4 150-mmg patients and 3 of 4 750-mmg patients were fused. There were 2 patients who had transient asymptomatic elevation of liver enzymes. One patient sustained a wound infection and eventually required reoperation. **Conclusion:** This is the first published human experience with the B2a BMP peptide. These preliminary data show that the peptide functions as well as autograft in obtaining fusion and in improving function after TLIF/pedicle screw construct fusion for degenerative conditions of the spine. This BMP has not demonstrated any permanent serious adverse events.

3.2.32

Comparison of preoperative qualitative and quantitative radiographic factors as predictors for outcome in lumbar discectomy. ***R. Jalal,*†* ***E. Vasarhelyi,*†* ***Z. Wali,** ***D. Yen.*†* **From the *Kingston General Hospital and †Queen's University, Kingston, Ont.**

Background: Our aim was to determine whether qualitative (disc morphology) and quantitative (area of thecal sac impingement) radiographic parameters correlate with the severity of disability when measured by patient-oriented outcome measures before and after lumbar discectomy. **Methods:** In total, 76 patients from the senior author's spine clinic were prospectively enrolled in the study between 1998 and 2003. All patients were radiographically evaluated with either CT or MRI and had radicular symptoms consistent with their imaging. Roland Morris Disability Questionnaire (RM) scores were collected pre- and postoperatively at 6 weeks, 1 year and 2 years. Patients' disc morphology was qualitatively categorized as a bulge, a protrusion or an extrusion by radiologists at our institution. Area of thecal sac impingement, calculated as a ratio of total thecal sac area for internal control, was used as a quantitative measure. Disc morphology and thecal sac impingement were statistically correlated with the change in RM scores (the difference between preoperative RM score and the RM score at 2 years) using Pearson and Spearman correlations. **Results:** There was a significant improvement ($p < 0.001$) between pre- and postoperative RM scores, with a total of 82% of patients experiencing successful outcomes at 2 years. Disc morphology showed only a very weak correlation with the change in RM scores (rho = 0.05). Similarly, there was almost no correlation between preoperative thecal sac areas and the change in RM scores (rho = 0.15). **Conclusion:** Patient selection is important for successful outcomes following lumbar discectomy. Preoperative predictors for successful outcome after lumbar discectomy are multifactorial. Our study shows that qualitative and quantitative radiographic findings have weak correlation with operative outcome as measured by RM scores. Radiographic parameters may be useful in determining the presence and the site of a disc lesion. However, they should not be used solely to guide patient selection independent of other predictors of successful outcome.

3.2.33

Does the degree of foraminal stenosis affect the outcome of decompressive surgery in patients with lumbar spinal stenosis? ***E. Wai,*†* ***A. Bakkai,*‡* ***I.H. Miles,** ***J. Reinglas,** ***D. Roffey.** **From the *University of Ottawa Spine Unit and the †Clinical Epidemiology Program, Ottawa Hospital Research Institute, Ottawa, Ont., and the ‡Department of Orthopedic Surgery, Tripoli Medical-Center, Alfateh University, Tripoli, Libya**

Background: Foraminal stenosis is often encountered in patients undergoing decompression for spinal stenosis. Given the increased resection of facets and the presence of the more sensitive dorsal root ganglion, it is hypothesized that patients with foraminal stenosis have poorer results in regards to postoperative outcomes. **Methods:** Thirty-one patients undergoing decompression without fusion for lumbar spinal stenosis were evaluated. The degree of foraminal stenosis was determined by 2 independent reviewers for absence of fat around the nerve roots. ImageJ digital imaging software was also used to evaluate the foraminal area. Patients with foraminal stenosis were compared with those without using the Oswestry Disability Index (ODI) and a numerical pain scale for back and leg pain at a minimum of 1 year follow-up. **Results:** There were no significant differences between the 2 groups (i.e., foraminal stenosis, $n = 20$ v. not having foraminal stenosis, $n = 11$) in regards to age, sex, comorbidities, number of levels operated on and preoperative ODI, back pain or leg pain scores. The foraminal area was significantly lower in the foraminal stenosis group. Patients without foraminal stenosis reported significant improvements in ODI (mean 26.0), back pain (mean 3.1) and leg pain scores (mean 5.5). Patients with foraminal stenosis reported significant improvements in ODI (mean 18.8) and leg pain (mean 2.5) but not in back pain (mean 0.3). Comparing the 2 groups, the patients with foraminal stenosis improved significantly less in regards to back pain ($p = 0.02$) and leg pain ($p = 0.02$). **Conclusion:** The results of this study suggest that presence of foraminal stenosis is a negative predictor for successful outcome following decompression surgery. This may be related to the increased instability that occurs when a foraminotomy is required. Spinal fusion may reduce this effect, and further study is required.

3.2.34

Relation between preoperative expectations and postoperative satisfaction and functional outcomes in lumbar and cervical spine patients: a multicentre study. ***A. Soroceanu,** ***K. McGuire,*† ***A. Ching,*‡ ***W. Abdu.*§ **From *Dalhousie**

University, Halifax, NS, and the Harvard School of Public Health, the †Beth Israel Deaconess Medical Center, Boston, Mass., the ‡Oregon Health and Science University, Portland, Ore., and the §Dartmouth-Hitchcock Medical Center, Lebanon, NH

Background: Patient expectations influence post-treatment outcomes, both surgical and nonsurgical. Existing studies evaluate the technical aspects of interventions and functional outcomes but fail to take into account patient expectations. This retrospective analysis of prospectively collected multicentre data aims to explore the relation between preoperative expectations and postoperative outcomes and satisfaction in lumbar and cervical spine surgery. The authors hypothesized that expectations dramatically affect spine patient satisfaction independent of functional outcomes. **Methods:** Patient data from lumbar and cervical spine patients collected prospectively using a patient health survey system were analyzed. The study included patients who underwent operative intervention (decompression with or without fusion) with at least a 3-month period of follow-up. Preoperative expectations were measured using the Musculoskeletal Outcomes Data Evaluation and Management System (MODEMS) expectation survey. Postoperative satisfaction and fulfillment of expectations were measured using the MODEMS satisfaction survey. Postoperative functional outcomes were measured using the Oswestry Disability Index and SF-36. Multivariate ordinal logistic regression modelling was used to examine predictors of postoperative satisfaction. Multivariate linear regression modelling was used to examine predictors of functional outcomes. **Results:** In total, 402 patients were included in the study. Significant predictors of increased satisfaction include: higher fulfillment of expectations regarding work ($p = 0.003$) and pain relief ($p = 0.008$), greater postoperative SF-36 ($p = 0.04$) and lower preoperative expectations regarding ability to exercise ($p = 0.03$). Lumbar spine patients were more satisfied than cervical spine patients. Significant predictors of better postoperative function include: higher expectations regarding sleep ($p < 0.0002$), fulfillment of expectations regarding work ($p < 0.0001$), sleep ($p = 0.03$) and daily activities ($p = 0.02$). Cervical spine patients had better functional outcomes ($p = 0.006$). **Conclusion:** This study showed that preoperative expectations and their fulfillment influence postoperative satisfaction in lumbar and cervical spine patients. This underlines the importance of taking preoperative expectations into account in order to obtain an informed choices based on patient preferences.

3.2.35

Anterior versus posterior surgical approaches to treat cervical spondylotic myelopathy: outcomes of the prospective multicentre AOSpine North America Cervical Spondylotic Myelopathy Study. ***M. Fehlings,*[*] B. Kopjar,[†] S. Tim Yoon,[‡] P. Arnold,[§] E. Massicotte,[*] A. Vaccaro,[¶] D. Brodke,[**] C. Shaffrey,[††] E. Woodard,[‡] R. Banco,[§§] J. Chapman,[†] M. Janssen,[¶¶] Rick Sasso,[***]C. Bono,[†††] M. Dekutoski,[‡‡‡] Z. Gokaslan.[§§§]*** **From the *University of Toronto, Toronto, Ont., the †University of Washington, Seattle, Wash., the ‡Emory Spine Center, Atlanta, Ga., the §University of Kansas, Kansas City, Kan., the ¶Thomas Jefferson University, Philadelphia, Pa., the **University of Utah, Salt Lake City, Utah, the ††University of Virginia, Charlottesville, Va., the ‡‡New England Baptist Hospital and the §§Boston Spine Group, Boston, Mass., the ¶¶Spine Education Research Institute, Denver, Colo., the ***Indiana Spine Group, Indianapolis, Ind., the †††Brigham and Woman's Hospital, Boston, Mass., the ‡‡‡Mayo Clinic, Rochester, Minn., and the §§§John Hopkins University, Baltimore, Md.**

Background: The optimal surgical approach to treat cervical spondylotic myelopathy (CSM) remains under debate, with varying opinions favouring anterior versus posterior surgical approaches. We present an analysis of a prospective observational multicentre study examining outcomes of surgical treatment for CSM. **Methods:** In total, 278 participants from 12 clinical sites in North American received anterior/posterior or combined surgery at the discretion of the surgeon. This study focused on participants who had either anterior or posterior surgery ($n = 264$, 87% follow-up rate). Outcome measures included the Modified Japanese Orthopaedic Assessment Scale (mJOA), the Nurick Scale, the Neck Disability Index (NDI) and the SF-36v2 physical (PCS) and mental (MCS) component summary scores. **Results:** Of the study participants, 64% received anterior (discectomy or corpectomy and fusion) and 36% posterior surgery (laminectomy and fusion or laminoplasty); 43% were female. Patients who received anterior surgery were younger (mean 52 [SD 11] v. 63 [SD 11] yr, $p < 0.01$) and had less severe myelopathy as assessed by the mJOA (13.5 and 11.8, respectively). There were no baseline differences in NDI or SF-36 scores between the anterior and the posterior groups. Patients in the anterior group had on average 3.1 vertebral levels operated on compared with 5.1 levels in the posterior group ($p = 0.0001$). At 12-month follow-up, there were statistically and clinically significant improvements in all outcome parameters in the anterior and posterior groups, respectively: mJOA (2.47, 3.62; $p = 0.0061$); Nurick (1.61, 1.62; $p = 0.9530$), NDI (12.77, 10.87; $p = 0.5126$), SF-36 PCS (6.73, 4.14; $p = 0.0869$) and SF-36 MCS (5.90, 5.16; $p = 0.6547$). After adjustment for baseline differences in key covariates, there were no significant differences between the anterior and posterior approaches. **Conclusion:** Patients with CSM show significant improvements in generic and disease-specific health-related outcome measures with anterior or posterior surgery. Importantly, patients treated with anterior techniques were younger, with less severe impairment and more focal pathology. Whereas there was a greater improvement in mJOA scores in posterior cases, this difference could be accounted for by differences in baseline characteristics.

3.3.36

Role of the osteopontin biological pathway in adolescent idiopathic scoliosis pathogenesis: How could these findings be useful for spine surgeons? ***A. Moreau,*[*†] A. Franco,[*] M.-Y. Akoume,[*‡] P.H. Rompré,[†] M.-H. Roy-Gagnon,[§] K.M. Bagnall,[¶] B. Poitras,[**] H. Labelle,[**] C.-H. Rivard,[**] G. Grimard,[**] S. Parent,[**] J. Ouellet.[††]*** **From the *Viscogliosi Laboratory in Molecular Genetics of Musculoskeletal Diseases, Sainte-Justine University Hospital Research Centre, the †Department of Stomatology, Faculty of Dentistry, the ‡Department of Biochemistry, Faculty of Medicine, Université de Montréal, the §Sainte-Justine University Hospital Research Centre,**

Montréal, Que., the ¶Department of Anatomy, Faculty of Medicine and Health Sciences, United Arab Emirates University, Al-Ain, United Arab Emirates, the **Orthopaedic Division, Sainte-Justine University Hospital, Université de Montréal, and the ††Orthopaedic Division, Montreal Children's Hospital, Montréal, Que.

Background: Adolescent idiopathic scoliosis (AIS) is an endophenotype that can be a consequence of multiple genetic defects in conserved biological pathways involved in the maintenance of spinal integrity and stability. The study of the molecular changes occurring in scoliosis animal models revealed an increased production of osteopontin (OPN) at the mRNA and protein levels and has thus led us to study the role of this multifunctional cytokine in the AIS pathomechanism. **Methods:** A group of 683 consecutive patients with AIS were compared with 262 healthy controls and 178 asymptomatic offspring born from at least 1 scoliotic parent and thus considered at-risk of developing the disorder. Plasma OPN and soluble CD44 receptor (sCD44) levels were measured by enzyme-linked immunosorbent assays. **Results:** Mean plasma OPN levels were significantly increased in AIS patients and correlated with disease severity, with average values of 655 (SD 279) ng/mL and 812 (SD 363) ng/mL for moderate (10°–44°) and severe (≥ 45°) spinal deformities, respectively, when compared with the healthy control group (537 [SD 233] ng/mL). Elevated plasma OPN levels were also found in the asymptomatic at-risk group (733 [SD 336] ng/mL), suggesting that these changes precede scoliosis onset. Mean plasma sCD44 levels were significantly lower in AIS patients with Cobb angles 45° or greater (359 [SD 190] ng/mL) compared with healthy controls (505 [SD 108] ng/mL). **Conclusion:** Our clinical data demonstrate that OPN is essential for scoliosis onset and curve progression, thus offering a first molecular theory to explain the pathomechanism leading to the asymmetric growth of the spine in idiopathic scoliosis. Identification of genes and circulating factors blocking OPN action will pave the way to innovative diagnostic tools and a rational basis for the development of future pharmacotherapies.

3.3.37

Toward a comprehensive understanding of adolescent idiopathic scoliosis (AIS) genetics: Why function matters to solve the AIS puzzle! ***A. Moreau,*† Q. Yuan,*‡ M.-Y. Akoume,*‡ N. Karam,*‡ M. Taheri,* S. Bouhanik,* H. Labelle,§ B. Poitras,§ C.-H. Rivard,§ G. Grimard,§ S. Parent,§ J. Ouellet.¶*** **From the *Viscogliosi Laboratory in Molecular Genetics of Musculoskeletal Diseases, Sainte-Justine University Hospital Research Centre, the †Department of Stomatology, Faculty of Dentistry, the ‡Department of Biochemistry, Faculty of Medicine, Université de Montréal, and the Orthopaedic Divisions, §Sainte-Justine University Hospital and the ¶Montreal Children's Hospital, Montréal, Que.**

Background: Although advancements in genomic technologies are transforming many aspects of how we conduct genetics and genomics studies, there has been only limited success thus far in deciphering complex diseases like adolescent idiopathic scoliosis (AIS). The limitation to such investigations has been the lack of methods to better stratify AIS patients. To overcome these problems, we have developed a functional test to stratify AIS patients into 3 functional subgroups. **Methods:** Osteoblasts isolated from AIS patients were selected for each functional subgroup and compared with osteoblasts obtained from healthy, matched controls. We used the Affymetrix DNA Chip HuU133 Plus 2.0 array that allowed the analysis of the expression level of 38 000 well-characterized human genes. Statistical analysis was performed by the empirical Bayes method using FlexArray software. Selection criteria include the magnitude of change in expression (at least ± 3-fold) and the 5% false discovery rate. **Results:** Among 38 000 human genes tested, we have found 8 genes specifically associated with the functional subgroup 1; 16 genes specifically associated with the functional subgroup 2; and finally, 11 genes specifically associated with the functional subgroup 3. Interestingly, only 19 genes were shared and affected to the same extent in all AIS functional subgroups exhibiting a similar curve pattern (double major), suggesting their role in the elaboration of this curve pattern. Indeed, most of these genes encode for regulatory proteins such as transcription factors regulating axial skeleton, somite development and extracellular matrix proteins. **Conclusion:** Our data further support our functional method of stratification of AIS patients and allow the identification of genes triggering scoliosis onset versus those predisposing to the development of a specific curve pattern. It is anticipated that some of these genes could be used as genetic markers to identify children at risk of developing scoliosis and to better predict their clinical outcomes.

3.3.38

The use of a decision tree based on the literature can efficiently output the levels of fusion alternatives in the surgical treatment of adolescent idiopathic scoliosis. ***P. Phan,* N. Mezghani,† J. De Guise,† H. Labelle.*** **From the *Research Centre, Sainte-Justine University Hospital Centre, and †LIO, Centre de recherche du CHUM, Montréal, Que.**

Background: Variability in selecting curve segments to fuse in adolescent idiopathic scoliosis (AIS) has been repeatedly documented. There are no clear guidelines to be used by surgeons. Our hypothesis is that a decision tree based on the literature could efficiently output surgical strategy alternatives in the selection of level of fusion. Our objectives are to create a decision tree based on current medical literature on AIS surgical treatment and to test that decision tree on a large multicentre database of AIS patients having received surgical treatment. **Methods:** A decision tree using Lenke classification for AIS and literature evidence based on that classification to determine levels of fusion was developed in MATLAB. A multicentre database of 1776 AIS patients who were surgically treated was used to compare output from the decision tree with surgical treatment realized by surgeons. **Results:** The decision tree outputs on average 3.5 pairs of levels of fusion per case. When the results are compared with surgical treatments recorded in the multicentre database, preliminary results demonstrate that at ± 1 level, 93% of upper instrumented vertebrae and 82% of lower instrumented vertebrae were correctly outputted by the decision tree. **Conclusion:** To allow optimization of surgical treatment of AIS, a decision tree can efficiently output surgical strategy alternatives. The integration of that decision tree in a software platform and its potential use to optimize surgical treatment will be demonstrated.

3.4.39

Web Survey of Physical Activity and Nutrition: adolescent idiopathic scoliosis patients (Web-SPAN AdISP).

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Background: Adolescent idiopathic scoliosis (AIS) is a spinal deformity that affects 1%–3% of children aged 10–16 years. It has been shown to negatively impact nutrition and physical activity levels in affected children. Treatments for AIS include observation, bracing and surgery. In this study, we used an online survey to evaluate the nutritional intake and physical activity levels of youths with AIS. The data were compared among treatment groups and to age-matched controls in the general population who had completed the same survey. **Methods:** Sixty-two patients completed the Web-Survey of Physical Activity and Nutrition, a validated 24-hour recall of dietary intake and physical activity, between November 2009 and January 2010. Dietary intake was evaluated using Canada's food guide recommendations. Physical activity was graded from 1 to 5. Data were analyzed using SPSS. **Results:** Nutritional intake of children with AIS was not significantly different than that of the general population. However, important differences were found when the scoliosis patients were stratified into treatment groups. Seventy-one percent of patients requiring surgery for AIS had poor diet quality, compared with 51% of the general population. The intake of meats and alternatives was significantly lower for the surgical group. Physical activity scores of all treatment groups of AIS patients were lower than controls, with the surgical group being the lowest scoring. The surgical group was significantly less physically active than the observation and brace groups. **Conclusion:** Poor nutrition and physical fitness are important considerations when planning major corrective surgery for scoliosis as these may negatively impact the surgical course and recovery. This research supports the need for programs aimed at improving the nutrition and physical activity levels of patients requiring surgery for AIS. This pilot study also highlights the need for further research in this area to better understand specific causes of nutritional deficiencies in patients with AIS.

3.4.40

Detecting clinically significant progression in adolescent idopathic scoliosis using surface topography indices.

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Background: Torso surface topography (ST) is a noninvasive technique that provides a 3-dimensional torso surface model. One primary goal of applying this emergent technique to adolescent idiopathic scoliotic (AIS) patients is to reduce their exposure to harmful radiographs (Levy et al., 1996) by successfully monitoring clinically significant scoliotic changes. Eleven torso shape indices have been previously identified to quantify the torso shape in all 3 anatomic planes (Swanson, 2007). In this study, changes in the indices associated with clinically significant scoliosis progression were assessed relative to the minimal detectable change (MDC; Stratford, 2004), determined via the within-operator repeatability. **Methods:** Torso surface data (InSpeck) were collected from 15 AIS patients (8–17 yr). The MDC was calculated 3 times at time one (T1) for each index (95% confidence interval), using the within-subject standard deviation (s; Bland and Altman, 1986), calculated as the square root of the average within-subject variance (var) [MDC95 = 1.96 * $\sqrt{(2)}$ *, where s = $(\text{var})^{1/2}$]. Five of 15 patients and 5 additional patients presented with clinically significant progression (Kane, 1977), with a Cobb angle change greater than 10° (range 10°–27°) at a second time point (T2). The data at T2 were processed 3 times, and the average index value from T1 was subtracted from the average at T2. The resulting differences were compared with the MDCs. **Results:** The MDCs for the indices were found to be 1.1°, 2.2°, 3.7 mm, 3.6, 7.1, 2.4 mm, 2.9 mm, 43.7, 7.8 and 1.6 mm for back surface rotation, principal axis of rotation, rib prominence, quarter area difference, aspect ratio, lateral centroid line, spinous process line, lateral inertia, anterposterior inertia and kyphosis, respectively. In the clinically significant progression group (n = 10), an average of 6 (SD 2) indices were greater than the MDC. **Conclusion:** The ST system shows substantial promise as a repeatable system for detecting clinically significant progression.

3.4.41

Larger curve magnitude is associated with increased perioperative health care resource utilization: a multicentre analysis of 422 adolescent idiopathic scoliosis curves.

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From the *University of British Columbia, the †BC Children's Hospital, Vancouver, BC, the ‡Shriners Hospital, Philadelphia, Pa., and the §Rady Children's Hospital, San Diego, Calif.

Background: Lengthy wait lists for surgery are common in publicly funded health care systems. Prolonged delays in scoliosis surgery can, however, lead to increasing deformity, which can have significant implications on the surgical and perioperative care required, subsequently impacting health care resources, with greater costs to the health care system. We aimed to determine whether surgical correction of larger AIS curves increased the use of health care resources and to identify potential predictors associated with increased perioperative health care resource utilization in the surgical care of AIS patients. **Methods:** A prospective, longitudinal multicentre study evaluating operative outcomes of AIS yielded patients with Lenke 1A and 1B curves. Surgical time, number of levels instrumented, length of hospitalization, lowest instrumented vertebrae (LIV) and allogenic blood transfusion were the primary outcomes studied. Multivariable regression was used to identify potential predictors influencing these health care resources. **Results:** In total, 422 patients with a mean age of 15 (SD 2) years were included. The mean thoracic curve was 51.6° (SD 9.5°). Larger curves lead to increase in surgical time ($p < 0.0001$), number of levels instrumented ($p < 0.0001$) and the need for blood transfusion with every 10° increase associated with a

1.5-times greater odds for receiving blood transfusion. Surgeon, bone graft method and LIV were strong predictors of surgical time (R^2 = 0.73). Length of hospital stay was influenced by surgeon and intraoperative blood loss (R^2 = 0.59), whereas percentage curve correction, upper instrumented vertebrae and surgeon were predictive of the number of levels instrumented (R^2 = 0.66). **Conclusion:** Correction of larger curves is associated with increased utilization of perioperative health care resources, specifically surgical time, number of levels instrumented and the need for blood transfusion. Policies affecting prolonged wait lists for scoliosis surgery must consider the added costs to the health care system when treating larger curves and should focus on reducing the wait times.

3.4.42

Does statistical significance of SRS-22 correlate with clinical significance? A multicentre longitudinal study evaluating the minimal clinically important difference of the SRS-22. ***F. Miyanji,*[*†] *B. Slobogean,*[*] *R. Varghese,*[†] *C. Reilly,*[*†] *R. Betz,*[‡] *P. Newton.*[§] **From the *University of British Columbia, the †BC Children's Hospital, Vancouver, BC, the ‡Shriners Hospital, Philadelphia, Pa., and the §Rady Children's Hospital, San Diego, Calif.**

Background: The SRS-22 is a commonly used outcome tool in patients with adolescent idiopathic scoliosis (AIS); however, limited data exist regarding the relation between the changes in the scores and patients' self-reported clinical changes over time. The minimal clinically important difference (MCID) was recently reported for the SRS-22 in an attempt to address this, allowing a more effective analysis of surgical treatment. Our aim was to describe the longitudinal trend in postoperative SRS-22 scores in a multicentre, longitudinal cohort and to compare these to the MCIDs to determine whether there is a clinically significant predictive trend for recovery. **Methods:** A prospective, longitudinal study evaluating operative outcomes of AIS yielded patients with SRS-22 data from the preoperative visit and postoperative visits at 6, 12 and 24 months. Descriptive statistics were used to summarize the mean score and 95% confidence intervals for each domain. A repeated-measures analysis of variance was used to detect a change in scores in each domain over time. Results were compared with the MCID data for the SRS-22. **Results:** In total, 81 patients with a mean curve of 48.2° were identified. The figure shows the mean scores for all domains with 95% confidence intervals. There was a statistically significant change in the mean scores in all domains noted over time ($p < 0.0001$). A clinically significant change in the mental health domain was noted at 2 years postoperatively. The MCID for self image was achieved at 6 months postoperatively. A clinically significant decline in the activity domain occurred within 6 months postoperatively but returned to baseline by 2 years. The MCID for improvement in the pain domain was not met. **Conclusion:** Despite statistically significant differences reached in all SRS-22 domains by 6 months postoperatively, clinically significant differences are achieved at different time points following surgery. Statistically significant differences in the SRS-22 may not correspond to clinically important differences.

Canadian Spine Society abstracts

Poster presentations

THURSDAY, MARCH 10, 2011

1.5.01

Early results of spinal decompression and reconstruction for spinal metastatic disease. ***G. Boubez,*[*] *B. Fortin,*[*†] *D. Dusseault,*[*] *Z. Wang.*[*] **From the *Centre Hospitalier de l'Université de Montréal and the †Hôpital Maisonneuve-Rosemont, Montréal, Que.**

Background: This retrospective review was conducted to evaluate the results of surgical decompression of spinal metastases in a large oncology facility. The purpose of surgery was to prevent paralysis and keep patients ambulant. **Methods:** The main selection criteria were severe cord or cauda equina compression, or severe mechanical pain. Charts were reviewed from Jan. 1, 2008, to April 2010. Statistics are essentially descriptive; some comparisons between groups were performed with Fisher and Student tests. **Results:** In total, 70 consecutive patients underwent surgery for spinal decompression and reconstruction. Their median age was 55. Of those, 33% had no previous diagnosis of cancer. All patients underwent vertebrectomy and reconstruction with cement and segmental instrumentation. Patients were more likely, although p was not significant, to be nonambulatory at presentation if their cancer was still undiagnosed (43% v. 30%) and if they were referred from a smaller hospital (45% v. 28%). The procedures were done at night, in the evening or on weekends in 44% of cases and lasted on average 210 minutes, but this decreased with time. The number of cases increased with time: 7 for the first and 27 for the last semester of that period. The median length of hospital stay was 13 days. Ambulation was preserved in 43 of the 46 ambulant patients, and 17 of the 24 nonambulant patients regained mobility. Only 3 patients lost their mobility. There was 1 death owing to surgical complication, but there were 4 deaths in all, 3 pulmonary embolisms, 3 infections, 10 dural tears, and 67% of patients had no reported complications. **Conclusion:** Surgical decompression is an effective procedure with reasonable complication rates considering this population with metastatic disease. Education could possibly reduce the rate of nonambulatory patients at diagnosis and decrease the rate of permanent paralysis.

1.5.02

Safety and efficacy of methyl methacrylate as a vertebral body replacement after metastatic spine tumour resection: results of a systematic review. ***M. Nikolakis, C. Fisher.* From the University of British Columbia, Vancouver, BC**

Background: The technique of using methyl methacrylate as a vertebral body replacement after metastatic spine tumour resection was initially reported in the literature in 1974. Since then, multiple publications have separately addressed the outcomes, complications and biomechanics of this technique. Here we report the results of the first systematic review on the safety and efficacy of methyl methacrylate as a vertebral body replacement after resection of metastatic spine tumours. **Methods:** Three medical databases were independently searched for papers published on the use of methyl methacrylate as a vertebral body replacement construct, either alone or in combination with spinal instrumentation. Papers discussing the use of vertebroplasty and kyphoplasty were excluded. Only original research papers were included. Abstracts were analyzed for relevance, and the reference section of each paper was searched to discover further papers on the topic. All papers deemed relevant to our systematic review were included in the results. **Results:** A total of 52 original research papers specifically addressed the topic of methyl methacrylate use as a vertebral body replacement after metastatic tumour resection. The majority of papers were case series of patients treated with vertebral body resection for various metastatic tumours. Seven papers specifically reported on the complications seen after methyl methacrylate use, including esophageal perforation, ureteric obstruction, airway compromise and the degree of dural temperature increase during methyl methacrylate hardening. Two papers specifically addressed the effect of methyl methacrylate vertebral body replacement on spine biomechanics. **Conclusion:** Overall, the results of our systematic review indicate that methyl methacrylate appears to be safe and effective as a vertebral body replacement after resection of metastatic spine tumours.

1.5.03

Lost to follow-up. Are postoperative recheck no-shows all doing well? A preliminary study from the CSS surgical registry. ***N. Manson,*[*†] *Y. Raja Rampersaud,*[‡] *E. Abraham,*[*†] *O. Persaud,*[‡] *M. McKeon,*[§] *C. Fisher.*[¶] **From the *Horizon Health Network, Saint John, NB, †Dalhousie University, Halifax, NS, the ‡University Health Network, Toronto, Ont., §Memorial University, St. John's, NL, and the ¶Vancouver General Hospital, Vancouver, BC**

Background: Postoperative evaluation is used to assure patient health and improvement in preoperative symptoms. It further confirms surgical success, providing valuable feedback regarding the utility of the given procedure for the individual's spinal pathology. This information is critical to support a surgeon's clinical decision-making and is necessary to validate surgical outcomes in research. **Methods:** In total, 215 patients enrolled in the CSS surgical registry were retrospectively analyzed. Patients presenting for 1-year surgical assessment were compared with patients failing to present for 1-year assessment. Baseline demographics, diagnosis, surgical variables and baseline and assessment standardized pain and function questionnaires were evaluated. Univariate analysis ($p < 0.05$) was used to compare differences in these variables between those patients returning and those lost to

follow-up. **Results:** Patients returning to 1-year assessment were of statistically greater age (57 v. 49 yr) and were less likely to be working (71% v. 41%). Patients with greater preoperative pain and disability (Oswestry Disability Index score 54 v. 46, visual analogue scale [VAS] leg score 7.6 v. 6.6, VAS back 7.8 v. 6.2) and with a diagnosis of spinal stenosis (48% v. 21%) were more likely to return at 1 year. Patients undergoing fusion procedures or procedures of greater than 1 level were more likely to return at 1 year. Patient-reported pain and disability at 6-month assessment was not statistically different between those attending or not attending the 1-year assessment and thus was not predictive of presentation at 1 year. **Conclusion:** Patients returning for 1-year assessment were older, possessed more baseline disability and received more complex surgical procedures than those not returning for assessment. Patient outcomes at the time of 6-month assessment did not predict attendance at 1 year. Further research strategies are needed to identify factors influencing patient compliance regarding follow-up and to confirm outcomes in patients failing to return.

1.5.04

Can referral triage scores predict surgical cases? ***H. Poushay, A. Robicheau, C. Wheeler-O'Neil, S. Christie.*** **From Dalhousie University, Halifax, NS**

Background: The spinal severity score (SSS) was developed by a group of neurosurgeons in Calgary to provide a standard triage system for spinal surgery patient referrals. The SSS was found to be a valid method of triaging patients; however, the study that supported this conclusion consisted of only 25 patient referrals, each with complete clinical and radiological information provided, which may not accurately represent the quality of referrals sent to neurosurgeons. To further evaluate the practical usefulness of the SSS, we applied the score to a cohort of patients referred to an academic spine surgeon. The initial goal was to determine if the referral information was consistent with the consultant's findings. Furthermore, it was hypothesized that an absolute "cut-off number" could be determined which would identify those patients highly unlikely to benefit from spinal surgery according to referral information. **Methods:** In total, 700 consecutive referral requests were reviewed and scored using a similar system to the SSS. Each patient was then "rescored" based on the detail contained in the initial consultation letter from the surgeon. The retrospective scoring system included clinical, radiological and pathological categories, each with a number of signs and symptoms, which if present resulted in a weighed point value awarded to the patient. **Results:** Preliminary statistical analysis did not demonstrate an absolute cut-off mark when using the scoring system to predict the need for surgery. However, total scores based on the initial referral information differed significantly from the scores determined from the consultant's letters. This is likely owing to the limited and often incomplete information provided in referral letters, and also partly owing to limitations in the imaging techniques available to family doctors. **Conclusion:** It is hoped that the results of this study will result in prompt further education to general practitioners on assessing spinal complaints and how to optimize the referral process.

1.5.05

The provision of emergent spinal care from a health care delivery perspective: results of a demonstration and evaluation project in the integration of care delivery. The UT-SpineLINK experience. ***A. Yee,* H. Malempati,† A. Singh,‡ K. Rice,§ F. Webster.§*** **From the *University of Toronto Department of Surgery Spine Program, the †University Health Network/Toronto Western Hospital, the ‡University of Toronto Department of Surgery, Division of Orthopaedic Surgery, and the §Holland Musculoskeletal Program, Sunnybrook Health Sciences Centre, Toronto, Ont.**

Background: The provision of emergent spinal care remains challenging. There is a desire to better integrate local, regional and national efforts in care delivery. Our aim was to characterize emergent spinal care delivery in Ontario and to define opportunities for further enhancing triage, patient transfer and access to care. **Methods:** Emergent spinal referrals to the provincially supported CritiCall Ontario Call Centre were reviewed from 2004 to 2010. The number of referrals, cases requiring emergent transfer and patient disposition following consultation were trended. Comparison of expenditures spent on patients transferred out of province for care when compared with local spinal case costing was performed. An ethnographic review using key stakeholder interviews identified existing operational challenges and opportunities for improvements. **Results:** A significant increase in the number of emergent spinal referrals were triaged through CritiCall Ontario from 2004 to 2010. Currently, about 1000 referrals are triaged annually, of which an increasing number require emergent transfer to a specialized centre (408 patients in 2009/10). Although many patients are accommodated by regional centres, a significant proportion are not and are transferred out of province (7.6% in 2009/10), at incremental costs (3.5-fold). Central themes emerged from ethnographic review. Clinicians and local and regional administrators unanimously agreed that the delivery of emergent spinal care is problematic, requiring urgent attention. There was agreement that a regional triage centre was considered an essential service, and opportunities existed to streamline the triage processes in order to optimize efficiencies. Spinal patients are often medically complex, requiring coordinated multidisciplinary collaboration of care. Improvements in evidence-based practice guidelines for spinal clearance are required that could be translated into improved care protocols. **Conclusion:** A coordinated approach transcending clinical and health care delivery providers is required to optimize care for patients. Comparative review of regional models across Canada will be important to national spinal access issues.

1.5.06

Obesity and early reoperation rates after elective lumbar spine surgery: a population based study. ***C. Gaudelli, K. Thomas.*** **From the University of Calgary, Calgary, Alta.**

Background: Our aim was to determine whether class II or III obesity increases the risk of early reoperation after elective lumbar spine surgery. We conducted a retrospective, population-based study of adults who underwent elective lumbar spine surgery in the province of Alberta, under provincial health coverage, from July 1, 2007, to June 30, 2009. **Methods:** The provincial health billing database was queried to identify eligible participants and stratify them as either morbidly obese (BMI $\geq$ 35) or of normal weight (BMI < 35). We then queried that

same database to determine which patients underwent a second operation within 3 months of the index procedure. Our main outcome measure was reoperation within 3 months of the index lumbar spine procedure. **Results:** A total of 3388 patients met the inclusion criteria and 9.8% of those were obese. In normal-weight patients, the reoperation rate was 2.9%, which compared with 4.8% for morbidly obese patients, putting the relative risk at 1.73. **Conclusion:** Morbidly obese patients may be at higher risk of early reoperation following elective lumbar spine surgery. Further statistical analysis of these data is pending and will be presented.

1.5.07

Do flexion–extension radiographs affect presurgical planning in patients suffering from lumbar compressive pathologies? ***N. Manson,*[*†] *M. Lamont,*[*‡] *M. McKeon,*[*] *S. Comstock,*[§] *E. Abraham.*[*†] **From the *Horizon Health Authority, Saint John, NB, †Dalhousie University, Halifax, NS, Canada, ‡Memorial University, St. John's, NL, and the §Moncton Hospital, Moncton, NB**

Background: The advocates of lumbar flexion–extension radiographs (FER) report improved accuracy in diagnosing and quantifying instability. However, others report no significant advantage over standard anteroposterior and lateral radiographs (APLR), thus imparting unnecessary radiation and cost. Our aim was to demonstrate the utility of FER in presurgical decision-making. **Methods:** Three fellowship-trained orthopedic spine surgeons independently evaluated 400 radiographs from 100 patients receiving decompression or decompression and fusion surgery. Each patient's radiographs were grouped (APLR or FER), and all 200 groups were evaluated in random order. Surgeons determined surgical plan for each pair of radiographs, and analysis confirmed if this surgical plan was altered after viewing the FER. The number of examiners who differed on the actual decision was analyzed using χ^2, and the variances in responses were analyzed with a mixed, repeated-measures analysis of variance ($p < 0.05$). **Results:** Poor agreement was noted between surgeons. Examiner 1 showed statistically significant variance depending on the radiographic view presented ($F_{1,3} = 10.32$), and the same examiner was significantly more accurate on the actual decision when using FER ($\chi^2 = 13.50$) as compared with APLR ($\chi^2 = 17.42$). Examiner 1 used FER routinely in clinical practice for presurgical decision-making. Examiners 2 and 3 remained constant in their error rate no matter which view was presented. Neither examiner used FER in clinical practice. **Conclusion:** Flexion–extension radiographs are valuable to surgeons trained to incorporate the images into clinical decision-making and are not necessary to surgeons not trained to incorporate their use. Future work should identify and quantify the components required for surgical decision-making for individual surgeons in an effort to understand the discrepancies in surgical planning among spine surgeons when treating patients surgically.

1.5.08

Decompression alone for low-grade degenerative spondylolisthesis: analysis of revision rate and radiographic risk factors for failure. ***R. Mobasheri,*[*] *H. Modi,*[*] *Y. Raja Rampersaud.*[*†] **From the *Division of Orthopaedic and Neurosurgery, Department of Surgery, University of Toronto, and the †Musculoskeletal Health and Arthritis Program and Krembil Neuroscience Program, Toronto Western Hospital, University Health Network, Toronto, Ont.**

Background: Decompression and fusion is the recommended surgical treatment for degenerative spondylolisthesis (DS). However, a selected subpopulation (leg-dominant pain with stable, grade 1 listhesis) has been reported to do well with anatomy-preserving decompression alone. The purpose of this study was to determine the revision rate and to identify any radiologic parameters that predict failure of decompression alone in this subset of DS patients. **Methods:** A retrospective analysis of 42 patients was performed. The clinical outcome measure was the Oswestry Disability Index (ODI) score. Radiographic parameters included pre- and postoperative percentage of listhesis, disc height, pelvic incidence, mean facet angle and facet fluid index. All parameters were compared between those who did or did not undergo revision. **Results:** Average follow-up was 19.1 (6–48) months. There was significant improvement in ODI scores for all patients, from a mean preoperative score of 42.2 (SD 15.6) to a postoperative score of 19.9 (SD 17.8; $p < 0.05$). **Conclusion:** This study demonstrates that decompression alone for a subpopulation of DS patients can achieve a good result (a 22-point reduction in ODI) with an acceptable revision rate (12%). No radiographic parameter predictive of failure could be identified.

FRIDAY, MARCH 11, 2011

2.5.09

Does intraoperative electromyography improve pedicle screw position on CT scan? ***E. Frangou,*[*] *J. Tynan,*[†] *L. Peeling,*[*] *L. Hnenny,*[*] *D. Fourney.*[*] **From the *Division of Neurosurgery and the †Department of Medical Imaging, University of Saskatchewan, Saskatoon, Sask.**

Background: Intraoperative spontaneous and evoked electromyography (EMG) is a tool to detect and avoid nerve root injury during pedicle screw placement. The objective of this study was to determine whether or not EMG improves the anatomic placement of pedicle screws. Most studies in this area have evaluated postoperative radiograph films. To our knowledge, no study to date has compared postoperative computed tomography (CT) scans in patients with and without EMG assistance in the placement of pedicle screws. **Methods:** We retrospectively analyzed cases of lumbar pedicle screw instrumentation for degenerative conditions between 2006 and 2009 at our centre. In each case, intraoperative C-arm fluoroscopy and EMG (spontaneous and evoked) were used to assist screw placement. We excluded cases where stereotactic navigation was also employed and when postoperative CT was not available. The CT scan was assessed by both a radiology resident and a neurosurgery resident, and disagreements were resolved by consensus. Pedicle breaches were graded as in or out. Screws were further graded by direction and degree of breach: A (in), B (< 2.1 mm), C (2.1–4.0 mm) and D (> 4 mm). Secondary outcomes included surgical time and postoperative neurologic status. **Results:** We evaluated 247 pedicle screws (144 in the EMG group and 103 in the control group). The indications for surgery and patient demographics were similar in both groups. There was no statistically significant difference

in the number, degree and type of pedicle breach in each group. However, there was a trend toward better neurologic outcomes ($p = 0.054$) and longer surgical time (mean difference 10 min, $p = 0.108$) in the EMG group. **Conclusion:** Surgeon-directed intraoperative EMG did not significantly affect the rate of pedicle breach on postoperative CT imaging. Intraoperative EMG monitoring may reduce poor neurologic outcomes at the expense of slightly longer surgical times.

2.5.10

Recovery after incomplete spinal cord injury is associated with synaptic plasticity: insights revealed by functional MRI of the human spinal cord using unique SEEP imaging. ***D. Cadotte,*† *P. Stroman,*† *R. Bosma,*† *D. Mikulis,** *M. Fehlings.*** **From the *University of Toronto, Toronto, and †Queens University, Kingston, Ont.**

Background: To date, we have relied on clinical examination to infer damage to motor and sensory circuits after traumatic spinal cord injury (SCI). Here we present spinal fMRI data that outline how these circuits change after SCI. **Methods:** Using an automated thermal delivery system, heat (44°C) was applied to 2 dermatomes above and 2 below the level of SCI. Spinal fMRI data were collected on a 3-T system using a signal enhancement by extravascular water protons (SEEP)-based protocol developed by our group (single shot fast spine echo, echo time 30 ms, repetition time 1 s). Data were spatially normalized and analyzed using the general linear model ($p = 0.0001$). A Granger causality analysis was performed on both an individual and group basis by selecting a prime cluster (active volume 10 mm^3) at the site of thermal sensation and outlining the temporal course of subsequently related clusters (active volume 10 mm^3), using a correlation coefficient R = 0.5. Spinal fMRI data were correlated with objective clinical outcomes assessments (American Spinal Injury Association sensory and Functional Independence Measure scores). **Results:** In total, 20 people were examined: 10 controls and 10 with incomplete SCIs that were determined to be chronic more than 12 months before analysis. Cluster-based connectivity analysis shows consistent changes in the neural activation pattern in persons with incomplete SCIs. There is a relative paucity of activity in persons with complete injury. Functional activity correlates with clinical measures. **Conclusion:** This represents the first attempt at applying a Granger causality analysis to fMRI data of the human spinal cord. We demonstrate that incomplete injury results in a reorganization of neural circuits within the human spinal cord.

2.5.11

Intraoperative neuromonitoring during spinal implant device lengthening surgeries. ***J. Norton, D. Hedden, J. Mahood.*** **From the University of Alberta, Edmonton, Alta.**

Background: Young children with spine or chest deformities require surgical procedures that do not arrest growth. Devices that can be lengthened as the child grows have been developed to meet these needs, although they do still carry a risk of premature fusion. The lengthening of these devices must be carried out at regular intervals. These procedures are often carried out as day surgeries and are comparatively short. However, these procedures still carry a risk of neurologic deficit. When the spine is lengthened, there is a risk of spinal cord damage, irrespective of how the spine is lengthened. In addition, the vertical expandable prosthetic titanium rib (VEPTR) device carries a risk of nerve damage to the brachial plexus. Children who undergo these procedures are often young and have complex medical issues. This can make neuromonitoring difficult, and it has been suggested that this is not a worthwhile endeavour. We report on our experience of monitoring these procedures over the past 3 years, during which time we have monitored a total of 62 device-lengthening procedures in 11 patients. **Methods:** The age of the patients ranged from 2 to 11 years. Using a total intravenous anesthetic protocol, and with normotension anesthesia, we were able to adequately record sensory and motor evoked potentials in the upper and lower limbs of all patients. **Results:** We experienced 2 changes in upper limb somatosensory evoked potentials related to positional events. In addition, there were 3 instances of changes in lower limb motor evoked potentials (in the absence of upper limb changes or technical issues) during device lengthening. In all instances, repositioning of the upper limb or releasing some of the distraction resulted in the restoration of the evoked potentials. All of the patients awoke neurologically intact. **Conclusion:** Neuromonitoring during device lengthening is a worthwhile procedure and may reduce the risk of neurologic deficit.

2.5.12

Evaluation of polyetheretherketone cages in anterior cervical discectomy with fusion using locally harvested bone. ***T. Cossetto,*† *S. du Plessis,** *G. Sutherland,*† *C. Fawaz,** *S. Mahajan.**** **From the *University of Calgary Spine Program and †Project neuroArm, Calgary, Alta.**

Background: We conducted a retrospective case series analysis of patients with previous anterior cervical discectomy and fusion (ACDF) to evaluate the clinical and radiographical outcomes of ACDF patients with polyetheretherketone (PEEK) cages packed with locally harvested bone graft. Although PEEK cages containing allograft and synthetic bone substitutes produce fusion rates comparable to traditional ACDF, additional costs and risk of disease transmission remain an issue. An alternative approach uses bone dust collected during the decompression to achieve fusion. **Methods:** In total, 48 levels in 38 patients who underwent ACDF between March 2006 and March 2010 were evaluated. Data were organized into groups with and without anterior cervical plating as well as groups with Solis or anterior cervical fusion (ACF) cages. Standard, lateral flexion–extension radiographs were performed 3 months postoperatively to evaluate for evidence of fusion and subsidence of the PEEK cages. Clinical outcomes were determined on average 18 months postoperatively using Odom's criteria. **Results:** There was a 100% fusion rate for the entire data set. Sixteen of the 21 patients (28 levels) in the plated group reported favourable clinical outcomes compared with only 7 of the 15 patients (19 levels) in the nonplated group (76% v. 47%, $p = 0.0715$). Four of the 28 cages in the plated group subsided compared with 5 of the 19 cages in the nonplated group (14% v. 26%, $p = 0.2555$). Nine (29%) of the 31 Solis cages subsided, whereas no subsidence of the 16 ACF cages was identified. Eleven of the 12 patients with ACF cages reported significant clinical improvements compared with 12 of the 25 patients with Solis cages (92% v. 48%, $p = 0.0109$). **Conclusion:** All of the cages packed with locally harvested bone produced excellent

fusion rates. Patients who were plated had slightly better clinical outcomes. Patients with the ACF cages had significantly better clinical and radiographic outcomes.

2.5.13

International variations in the clinical presentation and management of cervical spondylotic myelopathy: 1-year outcomes of the AOSpine Multi-Center Prospective Study. ***M. Fehlings,[*] B. Kopjar,[†] R. Bartels,[‡] H. Defino,[§] G. Barbagallo,[¶] P. Arnold,[**] Q. Zhou,[††] M. Zileli,[‡‡] G. Tan,[§§] O. Moraes,[¶¶] S. Kale,[***] C. Bolger,[†††] M. Alvarado,[‡‡‡] M. Scerrati.[§§§]*** **From the *University of Toronto, Toronto, Ont., the †University of Washington, Seattle, Wash., the ‡Canisius Wilhelmina Hospital, Nijmegen, Netherlands, the §University of Sao Paulo—Ribeirao Preto, Sao Paulo, Brazil, the ¶Medical University of Catania, Catania, Italy, the **University of Kansas, Kansas City, Kan., the ††Southwestern Hospital, Chongqing, China, the ‡‡Ege University, Izmir, Turkey, the §§Tan Tock Seng Hospital, Singapore, the ¶¶Hospital Santa Marcelina, Sao Paulo, Brazil, the ***All India Institute of Medical Sciences, New Dehli, India, the †††Beaumont Hospital, Dublin, Ireland, the ‡‡‡Hospital San Juan de Dios, Caracas, Venezuela, and the §§§Medical University of Ancona, Ancona, Italy**

Background: Little information is available with respect to differences in global approaches to treatment of cervical spondylotic myelopathy (CSM). **Methods:** In total, 403 patients with CSM were enrolled in a prospective multicentre controlled, cohort study involving 13 sites in Europe, Asia, South America and North America. Data were analyzed using multivariate techniques adjusting for baseline differences (demographics, surgical approach, number of levels and baseline outcome values) in patient populations. **Results:** Of the patients, 37.6% were female with an average age of 56.3 (SD 12.3) years. Patients underwent anterior (60.4%), posterior (37.3%) or circumferential (2.3%) surgery. There were significant differences in presentation and surgical approaches among the regions. In total, 208 patients have completed 1-year follow-up. There has been a statistically ($p < 0.01$) and clinically significant improvement in all outcome parameters. Mean (and SD) Modified Japanese Orthopaedic Assessment Scale (mJOA) scores improved from 12.5 (2.9) at baseline to 15.0 (2.7) at 12 months. Neck Disability Index scores improved from 38.6 (21.3) at baseline to 26.4 (18.8) at 12 months. Nurick scores improved from 4.4 (1.2) at baseline to 3.0 (1.5) at 12 months. SF-36 physcial component summary scores improved from 35 (8.6) at baseline to 43.3 (10.1) at 12 months. SF-36 mental component summary scores improved from 38.8 (9.8) at baseline to 45.5 (10.6) at 12 months. Asia and Pacific and Latin America had better outcomes then North America and Europe. **Conclusion:** This large prospective global clinical study shows that surgical treatment for CSM is associated with significant improvements in generic and patient-specific outcome measures at 1 year. Significant variations in extent of improvement need to be further investigated.

2.5.14

Is surgery for cervical spondylotic myelopathy cost-effective? Results of a prospective study with health utilities assessments. ***N.K. Jha,[*] M.G. Fehlings,[*] E.M. Massicotte,[*] K. Tung,[*] B. Kopjar.[†]*** **From the *University of Toronto, Toronto, Ont., and the †University of Washington, Seattle, Wash.**

Background: Surgical intervention for patients with cervical spondylotic myelopathy (CSM) in appropriately selected patients has demonstrated favourable outcomes. To the best of our knowledge, there are no prior studies evaluating the cost-effectiveness of this type of surgery. We have estimated the cost–utility ratio for CSM surgery. **Methods:** As a part of a larger prospective multicentre study, 71 patients undergoing surgery for CSM at a single institution were prospectively enrolled and followed for 12 months. The preoperative and 12-month postoperative health utilities were estimated using SF-6D utility values derived from the SF-36v2 scores. The costs of surgical treatment were obtained from hospital charge data. **Results:** The average age of patients was 55.15 (SD 11.86) years, with 31% being female. The SF-6D utilities improved from 0.59 preoperatively to 0.66 at 12 months postoperatively ($p < 0.01$). Costs of surgery were estimated at Can$18 230. Using a 10-year perspective with 3% discounting for utilities, there was a gain of 0.61 quality-adjusted life years (QALYs) over the 10-year period. The cost–utility ratio was calculated to be Can$29 885 per QALY. **Conclusion:** Surgery for CSM led to a statistically significant improvement in utility scores measured by SF-6D. The cost per QALY gained was well within the range of values that are deemed to be cost-effective. This study presents a strong case for the allocation of resources for CSM surgery.

2.5.15

Anterior versus posterior fixation for an isolated posterior facet complex injury in the subaxial cervical spine. ***S. McLachlin, P. Rasoulinejad, S. Bailey, K. Gurr, C. Bailey, C. Dunning.*** **From the University of Western Ontario, London, Ont.**

Background: Isolated posterior facet complex injuries are commonly treated with anterior and/or posterior instrumentation to facilitate fusion; however, no clear guideline exists as to the choice of surgical approach. The purpose of this study was to evaluate the effectiveness of anterior and posterior instrumentation for an isolated posterior facet complex injury with a preserved anterior discoligamentous complex. **Methods:** Six fresh-frozen cadaveric C2–C5 cervical spines were placed in a spinal loading simulator, capable of applying flexion–extension, lateral bend and axial rotation. Specimens were loaded at 3°/s up to the target load of 1.5 Nm. Range of motion (ROM) for each simulated movement was measured using an Optotrak Certus optical tracking system. The testing sequence was as follows: intact specimen, posterior facet complex injury, posterior instrumentation (C2–C4), anterior instrumentation (C3–C4) and combined posterior–anterior instrumentation. **Results:** With simulated flexion–extension movement, all treatments were found to reduce ROM from the injured state ($p < 0.05$), with no difference between the fixation methods ($p > 0.05$). However, for axial rotation movement, only posterior and posterior–anterior fixation combined were able to decrease ROM compared with injured state ($p < 0.05$), whereas anterior fixation alone failed to decrease ROM ($p > 0.05$). The decrease in ROM for lateral bend movement did not reach statistical significance for any of the fixation

methods; however, among the treatment groups, anterior fixation allowed greater ROM ($p < 0.05$). **Conclusion:** Results from this study demonstrate that anterior instrumentation alone in an isolated posterior injury was ineffective at reducing ROM. Whereas an isolated posterior injury represents only a small portion of the complete injury spectrum, the results of this study will help to guide the surgeon's approach when faced with managing this condition. It is likely that the necessary sacrifice of anterior discoligamentous stabilizers with the anterior approach inadvertently produces more instability, then is re-established by the application of bone graft and plate in the early postoperative period.

2.5.16

Comparison of the swimmer's and shoulder pull-down views for lateral cervical spine radiographs. ***A.T. Gupta, J. Reed, B. Kilb, B. Frizzell, J. Amuah, K. Thomas.*** **From the University of Calgary, Calgary, Alta.**

Background: Cervical spine plain radiographs for all high-energy trauma patients are part of the standard Advanced Trauma Life Support (ATLS) protocol. The optimal plain radiographic adjunct to the standard cross-table lateral (CTL) cervical spine view has yet to be determined. The ability of the swimmer's view (SV) and shoulder pull-down (SPDV) to visualize the entire cervical spine was evaluated. **Methods:** Healthy volunteers had a standard CTL cervical spine radiograph followed by SV and SPDV cervical spine radiographs. First, the CTL radiograph was assessed independently by a radiologist, 5 spine surgeons and a senior orthopedic resident to determine whether an adequate image was obtained. If an assessor determined the CTL radiograph was inadequate, they would then evaluate the adequacy of the SV and SPDV radiographs separately. Adequacy was defined as exposure of the entire cervical spine, including the end-plate and anterior corner of the T1 vertebral body. The McNemar test was used to compare adequacy proportions, and the intraclass correlation (ICC) assessed interobserver reliability of the imaging techniques. **Results:** Thirty participants were recruited with a mean age of 30.5 (SD 7.4) years. Only 22% of the CTL radiographs were considered adequate, whereas adequacy rates (95% CI) for the SV and SPDV methods were 61% (54%–68%) and 63% (56%–69%), respectively. Interobserver reliability of the SPDV (ICC 0.67, 0.54–1.0) was significantly greater than that of the SV (ICC 0.31, 0.19–1.0). **Conclusion:** In healthy participants, the vast majority of cervical spine CTL radiographs were inadequate. Both the SV and SPDV radiographs commonly provided adequate visualization of the entire cervical spine; however, the interobserver reliability of the SPDV was greater. This study suggests the SPDV may be the most suitable adjunct to the standard CTL cervical spine radiograph. Prospective evaluation in the trauma population is warranted.

SATURDAY, MARCH 12, 2011

3.5.17

Sagittal spinopelvic parameters of children with early onset scoliosis. ***R. El-Hawary,* P.F. Sturm,† P.J. Cahill,‡ A.F. Samdani,‡ M.G. Vitale,§ P.G. Gabos,¶ N.D. Bodin,** C.R. d'Amato,†† C. Harris,† J. Smith.‡‡*** **From the *IWK Health Centre, Halifax, NS, the †Shriner's Hospital, Chicago, Ill., the ‡Shriner's Hospital, Philadelphia, Pa., the §Morgan Stanley Children's Hospital, New York, NY, ¶Orthopaedics, Dupont, Wilmington, Del., the **Department of Orthopaedics and Sports Medicine, Temple University, Philadelphia, Pa., the ††Shriners Hospital, Portland, Ore., and the ‡‡University of Utah School of Medicine, Primary Children's Medical Center, Salt Lake City, Utah**

Background: Spinopelvic parameters describe the orientation, shape and morphology of the spine and pelvis. In children without spinal deformity, these parameters have been shown to change during the first 10 years of life; however, spinopelvic parameters need to be defined in children with significant early onset scoliosis (EOS). This study's purpose is to examine the effects of EOS on spinopelvic alignment. We hypothesize that sagittal spinopelvic parameters for patients with EOS will differ from age-matched healthy controls. These values will act as a baseline for future studies and may predict postoperative complications such as proximal junctional kyphosis and implant failure in children being treated with growing systems. **Methods:** Standing, lateral radiographs of 82 untreated patients with EOS greater than 50° were evaluated. Sagittal spine parameters (sagittal balance, thoracic kyphosis [TK], lumbar lordosis [LL]) and sagittal pelvic parameters (pelvic incidence [PI], pelvic tilt [PT], sacral slope [SS], modified pelvic radius angle [PR]) were measured. These results were compared with those reported by Mac-Thiong and colleagues (*Spine*, 2004) for a group of similar-aged children without spinal deformity. **Results:** These patients had a mean age of 5.2 years and scoliosis of 73.3° (SD 17.3°). Mean spine parameters were: sagittal balance (+2.4 [SD 4.03] cm), TK (38.2° [SD 20.8°]) and LL (47.8° [SD 17.7°]). These values were similar to asymptomatic patients. Mean sagittal pelvic parameters were: PI (47.1° [SD 15.6°]), PT (10.3° [SD 10.7°]), SS (35.5° [SD 12.2°]) and PR (57.1° [SD 21.2°]). Although PI was similar to age-matched controls, PT was significantly higher and SS trended lower in the study population. **Conclusion:** Sagittal plane spine parameters in children with EOS were similar to those found in children without spinal deformity. Likewise, pelvic parameters (PI, SS, PR) were similar; however, those children with EOS showed signs of pelvic retroversion (increased pelvic tilt).

3.5.18

Variability in the measurement of sagittal spinopelvic parameters in children with early onset scoliosis. ***R. El-Hawary,* J. Howard,* K. Cowan,* P. Sturm,† C. d'Amato.‡*** **From the *IWK Health Centre, Halifax, NS, the †Shriners Hospital, Chicago, Ill., and the ‡Shriners Hospital, Portland, Ore.**

Background: Spinopelvic parameters describe the orientation, shape and morphology of the spine and pelvis. These parameters have been shown to change during the first 10 years of life in children without spinal deformity. Spinopelvic parameters have not been defined in children with significant early onset scoliosis (EOS). Sagittal plane alignment may influence the natural history and the outcome of interventions for EOS. Spinopelvic parameters are therefore being defined for this population. Based on landmarks used for measuring these parameters, there may be inherent

error taking these measurements of the immature pelvis. This study's purpose is to define the variability associated with the measurement of spinopelvic parameters in children with EOS. **Methods:** Standing, lateral radiographs of 11 patients with untreated EOS were evaluated. Sagittal spinopelvic parameters (pelvic incidence [PI], pelvic tilt [PT], sacral slope [SS], modified pelvic radius angle [PR]) were measured. In order to assess intraobserver reliability, these measurements were repeated 15 days apart. To define interobserver reliability, radiographs were measured by 2 independent observers. **Results:** Average age and Cobb angle were 5.7 years and 80.8°, respectively. Repeated single observer measurements demonstrated no significant differences for all parameters. Paired samples correlations demonstrated a moderate correlation between measurements of PI (0.564). Stronger correlations were demonstrated for measurements of PT (0.816), SS (0.947) and PR (0.789). Interobserver analysis demonstrated a significant difference in measurement of SS ($p = 0.003$). Measurements of PI, PT and PR were not significantly different between independent observers. **Conclusion:** Intraobserver variability yielded acceptable correlations for PT, SS and PR; however, only a moderate correlation was found for PI. The intraobserver and interobserver variability of measurements for PT and PR were found to be superior than those for PI and SS. This may result from difficulties determining the sacral end plate orientation in the immature pelvis when measuring PI and SS.

3.5.19

Use of the S-hook as pelvic foundation as part of the vertical expandable prosthetic titanium rib (VEPTR) construct: a review of 44 patients. ***N. Ramirez,*[*] *J. Flynn,*[*] *J. Smith,*[†] *M. Vitale,*[‡] *C. D'Amato,*[§] *Ron El-Hawary,*[¶] *Tricia St. Hilare.*[**]** **From the *Hospital La Concepcion, San German, Puerto Rico, the †University of Utah School of Medicine, Primary Children's Medical Center, Salt Lake City, Utah, the ‡Columbia/Presbyterian, New York, NY, the §Shriners Hospital, Portland, Ore., the ¶IWK Health Centre, Halifax, NS, and the **Shriners Hospital, Philadelphia, Pa.**

Background: Multiple methods are available for distal anchoring of spine- and rib-based growing rod systems for early onset scoliosis (EOS). One of these methods, pelvic S-hooks, was initially recommended for patients with spina bifida or for severe thoracolumbar curves. No study has yet analyzed the clinical and radiographic effects of S-hooks on patients with rib-based instrumentation. The purpose of this study is to retrospectively review the results of S-hook pelvic fixation in patients with rib-based instrumentation. **Methods:** A multicentre, retrospective, institutional review board–approved study was conducted in all patients treated with rib-based constructs using S-hooks for pelvic fixation. Preoperative and postoperative clinical variables, radiological measurements, as well as the incidence and management of complications were evaluated in patients with a minimum of 2 years' follow-up. **Results:** In total, 44 patients, of whom 26 were female, were studied and had a mean age at surgery of 71 months. The most common surgical indication was progressive neuromuscular scoliosis. The average preoperative Cobb angle was 64° and at most recent follow-up (mean 45 mo) was 53°. The most common construct was dual rods resting over the iliac crest without suture to the iliac crest extending from T3/T4 ribs to the pelvis using domino (REH2) connectors. Forty-five of the patients had complications, of which S-hook migration after the initial procedures was the most common. S-hook migration was corrected at the next lengthening with repositioning of the hook to the iliac crest. No correlation was found between the complication rates and the clinical, radiographic and surgical technique variables evaluated. **Conclusion:** Controlling spinal deformities without fusion presents numerous challenges. S-hooks can migrate off the iliac crest, requiring repositioning of implants during subsequent lengthening. This highlights the need to explore different fixation techniques with a stronger attachment to the iliac crest.

3.5.20

Prediction of brace treatment outcomes. ***E. Lou,*[*†] *D. Hill,*[*] *D. Hedden,*[†] *M. Moreau,*[†] *J. Mahood,*[†] *J. Raso,*[*] *E. Parent.*[†]** **From the *Alberta Health Services and the †University of Alberta, Edmonton, Alta.**

Background: Brace treatment is the most widely used nonsurgical treatment for adolescent idiopathic scoliosis (AIS). Brace wear characteristics must be investigated to objectively determine its efficacy. A compliance monitor was used to log how patients used their braces. By understanding brace usage, the risk of progression and curve flexibility may help predict the outcome of brace treatment. **Methods:** A 3-year follow-up study of predicting brace treatment outcomes through a retrospective radiographic review with 20 AIS patients was performed to develop the curve prediction model. Six new AIS patients requiring full-time brace wear (23 h/d) participated in this study after the curve progression prediction model was developed. These 6 patients were monitored for 3 months immediately after they were prescribed their braces. They have been followed for 2 years, and their data were used to validate the model. **Results:** The average time that the first 20 patients used his/her brace was 15.6 hours (70% of the prescribed time). The equation of the curve progression model was: 33 + 0.11*Peterson Risk(%) – 0.07*Flexibility(%) – 0.45*Quality(%) – 0.48*Quantity(%) + 0.0062*Quantity*Quality. Flexibility was based on initial brace correction. The individual weighting correlated with curve progression: risk of progression (0.08), curve flexibility (–0.19), quality (–0.14), quantity (–0.10) and quality and quantity of brace usage (–0.17). These 5 factors predicted 56% of the variance in curve progression. The 6 patients' actual curve progression at 2 years following brace treatment was predicted with an average error of 1.3° (SD 1.4°). **Conclusion:** To be effective, the brace must be worn as prescribed in both tightness and time manners. Brace tightness and wear time are predictors of treatment effect. The model developed in this study may be a reliable method of predicting brace treatment outcomes, valuable for understanding of appropriate treatment protocol and to motivate patient cooperation in brace wear.

3.5.21

An updated (2010) systematic review of acute low back pain. ***G. McIntosh, H. Hall.*** **From the CBI Health Group, Toronto, Ont.**

Background: We previously performed a systematic review of acute low back pain (LBP) treatments in 2007. This abstract updates that initial review, current to May 2010. **Methods:** Databases searched included MEDLINE, EMBASE, the Cochrane

Database of Systematic Reviews and other important databases, up to May 2010. We included harms alerts from the Food and Drug Administration and the UK Medicines and Healthcare products Regulatory Agency in our search. Inclusion criteria were treatment studies of acute LBP of less than 12 weeks' duration, without radiation, published in English, at least single-blinded and containing sample sizes of at least 20 participants with minimum 80% follow-up. Studies excluded LBP attributed to a recognizable pathology (infection, tumour, osteoporosis, rheumatoid arthritis, fracture, inflammation) or solely addressing sciatica and/or herniated discs. **Results:** In 2007, we included 28 articles; the current 2010 review includes 14 additional systematic reviews, randomized controlled trials or observational studies that met our inclusion/exclusion criteria. The evidence for 18 acute LBP treatments was graded and summarized. For oral drug treatments, NSAIDs and muscle relaxants are still viewed as trade-offs (benefits/harms); the effectiveness of analgesics is still unknown. For local injections, the effectiveness of epidural injections is still unknown. For nondrug treatments, bed rest is still regarded as ineffective/harmful; the effectiveness is still unknown for acupuncture, back schools, behavioural therapy, electromyographic biofeedback, exercise, lumbar supports, massage, multidisciplinary treatment, temperature treatments, traction and transcutaneous electrical nerve stimulation. There was no new evidence to support the benefits of advice to stay active; recent research contradicts the previously stated effectiveness of spinal manipulation. **Conclusion:** Based on the past 3 years of research, there is little new evidence to alter the previous effectiveness ratings for the treatments graded in this review. There is either a lack of evidence or contradictory findings for most approaches to treatment of acute LBP with no recognizable pathology.

3.5.22

Surgical site infection and complications with the use of autograft versus allograft bone for spinal fusion. ***J. Couture, F. Cabana.*** **From the Université de Sherbrooke, Sherbrooke, Que.**

Background: In spinal fusion, the choice between autograft and allograft is currently based on several factors. Among them, postoperative infection and donor-site morbidity have been a concern with allograft and autograft, respectively. Secondary infection is determined by positive postoperative culture or positive intraoperative allograft culture. **Methods:** We retrospectively reviewed the cases of 338 patients from 1999 to 2009 who had an autograft (174) or allograft (164) for spinal fusion with a minimum of 1 year of follow-up in our institution. Allografts were intraoperartively cultured or not, depending on the spine surgeon. All patients received antibiotic prophylaxis at the time of induction. As a primary outcome, postoperative infections were based on a postoperative positive culture of the surgical site. We also included positive intraoperative culture of allograft specimens. As a secondary outcome, operative time, blood loss, blood product transfusions and time of hospitalization were compared between both groups. **Results:** There were 9 infections in all 338 cases (2.7%). There was no significant difference between allograft (3.7%) and autograft (1.7%) groups. All postoperative infections occurred in patients with instrumentation and elective procedures. Of 53 intraoperative cultures, 5 were positive (9.4%), and none of them led to antibiotic therapy or surgical revision at 1 year. Operative time, blood loss, blood product transfusions and time of hospitalization were all significantly higher in allografts compared with autografts for the group who underwent cervical spinal fusion. **Conclusion:** Perceived association with infection should not influence the surgeon in bone graft choice for spinal fusion. Routine sampling of allografts for cultures may be called into question, since positivity is higher than the currently reported infection rate with allografts (9.4% v. 1.4%), and positive results did not correlate with antibiotic therapy or surgical reintervention. Patients should be informed of the risks and benefits of autograft for arthrodesis procedures, especially at the cervical level.

3.5.23

Radiologic assessment of lumbar spine fusion: Is it (con)fused? ***C. Goldstein, S. Petis, M. Kowalczuk, B. Drew, B. Petrisor, M. Bhandari.*** **From McMaster University, Hamilton, Ont.**

Background: The lack of consensus regarding the radiologic criteria required to diagnose spinal nonunion limits the inferences that can be drawn from clinical research. This systematic review aimed to examine the spectrum of radiologic investigations to assess lumbar spinal fusion and the definitions of successful union used in the spine literature. **Methods:** We comprehensively searched 3 electronic databases from 1950 to 2009 (MEDLINE, EMBASE and the Cochrane Central Register of Controlled Trials) for clinical studies involving posterolateral fusion of the lumbar spine. English-language studies including adult patients and reporting a definition of successful fusion were included. Studies examining the reliability and validity of radiologic investigations were also identified. Key measures included radiologic investigations, definition of successful lumbar fusion and the reliability, sensitivity and specificity of the investigations used to assess the spinal fusion. **Results:** Among 1165 potentially eligible studies, 91 met our inclusion criteria. Of the studies, 78% (n = 71) used plain radiographs to diagnose nonunion, 4% (n = 4) used CT scans and 18% (n = 16) used both. In total, we identified 52 different radiographic definitions of successful fusion. More than half of the studies (n = 50, 55%) failed to provide a reference for the definition used. The most common definition of fusion (7 studies) used static radiographs and defined fusion as continuous intertransverse bony bridging at all intended levels. Seven studies evaluated reliability of radiographic criteria, but no studies provided complete validation of the definitions. Only 3 studies provided some validation and reliability estimates of CT scanning in diagnosing spinal nonunion. **Conclusion:** The radiologic investigations and definitions of successful posterolateral fusion used in the spine literature vary substantially. Choice of radiologic criteria should be based upon reliability and validity testing. Studies using fusion criteria that have not been shown to be reliable or valid should be interpreted with caution.

3.5.24

Radiologic assessment of lumbar spine fusion: a Canadian perspective. ***C. Goldstein, N. Hassan, M. Bhandari, B. Petrisor, B. Drew.*** **From McMaster University, Hamilton, Ont.**

Background: Surgical exploration remains the gold standard for diagnosing spinal nonunion. As this is impractical in the majority

of patients, radiologic investigations play an important role in spine fusion assessment. The purpose of this survey is to examine the methods by which Canadian spine surgeons diagnose lumbar spine nonunion. **Methods:** Using a cross-sectional survey design, we examined the methods by which spine surgeon attendees of the 2010 annual meeting of the Canadian Spine Society as well as absentee surgeon members of the Canadian Spine Society diagnose lumbar spine nonunion in their clinical practice. **Results:** Of the 110 spine surgeons invited to participate, 23 completed the survey, for a response rate of 21%. All of the survey respondents were men, with a mean age of 49 (range 35–67) years. The most common primary investigation used to diagnose lumbar spinal nonunion was computed tomography with sagittal and coronal reconstructions (46%). Whereas lateral flexion–extension radiographs are used by Canadian spine surgeons to diagnose lumbar spine nonunions, they are more likely to be a secondary (33%) or tertiary (25%) investigation. The most common CT criterion for making a diagnosis of nonunion was a lack of bridging bone across the fusion site (73%). The most common criterion for diagnosing nonunion on static radiographs was hardware failure (53%). **Conclusion:** The most common criteria for diagnosing nonunion of a posterolateral fusion of the lumbar spine used by Canadian spine surgeons is a lack of bridging bone seen on a CT scan with sagittal and coronal reconstructions. This differs markedly from the spine literature. It is therefore possible that the results of current studies based on radiologic assessment of posterolateral lumbar spine fusion using plain radiographs may not necessarily apply to Canadian spine patients.