Canadian Journal of Surgery
Journal canadien de chirurgie

Vol. 49, Suppl., June / juin 2006
www.cma.ca/cjs

Canadian Spine Society

Sixth Annual Meeting

Fairmont Chateau
Lake Louise,
Lake Louise, Alberta

Wednesday March 22 to
Saturday March 25, 2006

Société canadienne du rachis

Sixième réunion annuelle

Fairmont Chateau
Lake Louise,
Lake Louise (Alberta)

Du mercredi 22 mars au
samedi 25 mars 2006

Lifetime Achievement Award • Prix d'excellence pour l'ensemble des réalisations

Program • Programme

Abstracts • Résumés

Lifetime Achievement Award — 2006
Prix d'excellence pour l'ensemble des réalisations — 2006

John P. Kostuik, MD

Professor Emeritus, Departments of Orthopaedic Surgery and Neurosurgery, Johns Hopkins University, Baltimore, Md.

John P. Kostuik

Education

- Graduated Queen's University School of Medicine, 1961
- Residency at the University of Toronto, 1961–1967
- Residency mentors R.B. Salter, Ian MacNab and John Hall
- One year of research with Dr. Salter
- Fellowships: Duncan Fellow 1967–1968 University of Toronto; McLaughlin Traveling Fellow, Europe 1968–69, Japan 1981
- Certified in orthopedics, 1967

Academic positions

- Faculty, Orthopaedics, University of Toronto, 1967–91
- Professor, Department of Orthopaedics, University of Toronto, 1983
- Professor of Orthopedics and Neurosurgery, Johns Hopkins University, 1991–2004
- Chief of Spinal Surgery, Johns Hopkins University, 1991–2004
- Chairman of Orthopedics, Johns Hopkins University, 1999–2001
- Chairman of the Board, K2M, current

Professional positions

- President, Scoliosis Research Society, 1987
- President, North American Scoliosis Society, 1991
- Member: Scoliosis Research Society, North American Spine Society, Cervical Spine Research Society, International Society for the Study of the Lumbar Spine and 12 other societies including the American Orthopaedic Association, the Canadian Orthopaedic Association and the French, Belgian, Japanese, Argentinean and Ecuadorian Orthopedic Associations

Awards and honours

- Traveling fellowships
- Scoliosis Research Society Traveling Fellow (mentor) Asia 2001
- Russell Hibbs Awards, North American Spine Society
- Wiltse Award, North American Spine Society
- Farfan/Selby Award, North American Spine Society
- Visiting professorships: 80 universities in 29 countries

Publications

- Editorial Boards of the *Journal of Bone and Joint Surgery*, *Spine*, the *Journal of Spinal Disorders* and the *Spine Journal*
- 120 peer-reviewed papers and 3 textbooks

Dr. Kostuik is married to wife Elizabeth and has 3 children. His hobbies include wood carving, golf, travel, lecturing and teaching.

Canadian Spine Society
Sixth Annual Meeting

Société canadienne du rachis
Sixième réunion annuelle

Program / Programme

Wednesday, March 22, 2006 / Le mercredi 22 mars 2006

Executive committee meeting / Rencontre du comité exécutif

Thursday, March 23, 2006 / Le jeudi 23 mars 2006

Plenary session / Assemblée plénière
Symposium / Symposium
Whiplash / Traumatisme cervical
Annual General Meeting

Friday, March 24, 2006 / Le vendredi 24 mars 2006

Plenary session / Assemblée plénière
Symposium / Symposium
Paediatrics / Pédiatrie
Banquet / Banquet
Lifetime Achievement Award / Prix d'excellence pour l'ensemble des réalisations

Saturday, March 25, 2006 / Le samedi 25 mars 2006

Plenary session / Assemblée plénière
Symposium / Symposium
Kyphoplasty versus vertebroplasty / Kyphoplastie versus vertébroplastie

CSS 2006 — Podium presentations

Thursday, March 23, 2006

OUTCOME ANALYSIS OF PEDIATRIC CHANCE FRACTURES. *S. Tredwell, C. Reilly, K. Mulpuri, A. Jawadi, N. Saran, R. Choit.* **University of British Columbia and British Columbia's Children's Hospital, Vancouver, BC.**

Introduction and aims: The aims of this study were to assess the clinical, radiological and functional outcomes following the treatment of a lumbar Chance fracture and to analyze the spectrum of associated abdominal injuries as seen in the seat belt syndrome. **Method:** All patients diagnosed with L1–L4 Chance fractures at the British Columbia Children's Hospital were included in this study. Patient data, injuries, treatment and complications were collected from hospital charts. A review of all available spinal radiology including pre-treatment, post-treatment and follow-up x-rays, CTs and MRIs was done to measure pre-treatment, post-treatment and follow-up kyphosis angles. We have also described and calculated a Chance fracture deformity index. Patients were seen at follow-up to assess for range of motion, tenderness and neurologic status. Furthermore, a functional outcome questionnaire by the American Academy of Orthopaedic Surgeons (AAOS) Pediatric Instruments was completed by the patients. **Results:** Between December 1984 and February 2001, 27 patients aged 3–17 years were treated for lumbar Chance fractures. The mean age at injury was 11.1 years. There were 17 females and 8 males. All injuries occurred as a result of a motor vehicle accident. Seventeen were rear-seat passengers, and 8 were front-seat passengers. Of the 25 patients, 17 were treated surgically. Of these 17, 7 were treated with either pedicle screws or laminar hooks and rods, 4 with intersegmental spinous process (ISP) wires alone, 2 with sublaminar wires and 4 with a combination of screws/hooks, rods and ISP wires. Of the 8 patients treated conservatively, 4 were treated with a hyperextension cast and 4 were treated with a hyperextension brace. Twelve patients had abdominal injuries. Three cases involved abdominal arterial vascular trauma. Significant improvement in intra-vertebral kyphosis, segmental kyphosis and vertebral kyphosis remodelling (6.5° v. 4°) was noted in the operative group compared with the nonoperative group. The disease-specific AAOS Lumbar Spine Questionnaire scores were poor for pain and disability: 29.22 (26.41–31.98); but the SF-36 scores for both MCS and PCS were within the normal range: 47.79 (44.03–51.54) and 47.71 (42.59–52.82), respectively. **Conclusion:** An abdominal and spinal CT must be taken when presented with a Chance fracture with abdominal symptoms. Injury type and kyphosis angle are the main factors that aid in treatment planning in pediatric lumbar chance fractures. A purely soft-tissue injury or a kyphosis angle greater than 20° requires surgical intervention.

IMPROVEMENT IN QUALITY OF LIFE FOLLOWING SURGERY FOR ADOLESCENT IDIOPATHIC SCOLIOSIS (AIS). *A. Howard, S. Donaldson, D. Hedden, D. Stephens, B. Alman, J. Wright.* **Division of Orthopaedic Surgery; Population Health Sciences; and Department of Surgery, The Hospital for Sick Children, Toronto, Ont.**

Purpose: To assess the change in disease-specific quality of life associated with operating on patients with AIS compared with nonoperative patients. **Method:** The Climent Quality of Life Profile for Spinal Deformities (QLPSD) scale was administered prospectively to 119 patients undergoing scoliosis surgery and 42 patients followed for bracing or observation. Change in quality of life after 2 years (adjusted for baseline quality of life) was used to estimate the short-term benefit of scoliosis surgery. Bracing status was also analyzed at baseline as a covariate to determine its effect on improvement in quality of life. **Results:** The operated group experienced an increase in quality of life of 4.3 points (95% confidence interval 0.69–7.88) on the 105-point Climent scale. Although statistically significant, this increase was lower than the 5.5-point cutoff we had defined a priori as clinically significant. Among the operative patients, there was no difference in the quality of life score between those braced at baseline (91.2) and those not (90.5) ($p = 0.73$). In nonoperative patients, those braced had a baseline quality of life score of 88.2, and those not braced, 83.3; this difference was also not significant ($p = 0.13$). **Conclusions:** Scoliosis surgery results in a small increase of questionable clinical significance in spine-related quality of life at 2 years. **Significance:** Decisions to operate on adolescents with scoliosis should acknowledge modest expectations for short-term gains in quality of life.

Funding: This trial was funded by (in alphabetical order) the Canadian Institutes of Health Research, DePuyAcroMed-Johnson & Johnson Medical Products and Synthes, Canada.

THE USE OF INTRAOPERATIVE SKELETAL (SKULL–FEMORAL) TRACTION IN THE SURGICAL MANAGEMENT OF SCOLIOSIS. *S. Jhaveri, S.J. Lewis.* **Spinal Program, Toronto Western Hospital, University of Toronto, Toronto, Ont.**

Background: Traction has been described in the use of curve correction in scoliosis usually preoperatively or following anterior release. Intraoperative skull–femoral skeletal traction during posterior scoliosis correction offers multiple potential benefits: (1) scoliosis correction; (2) it facilitates spinal exposure by decreasing curve magnitude; (3) it provides balanced spine; (4) it minimizes forces applied to fixation points to gain scoliosis correction; (5) it levels pelvic obliquity in neuromuscular curves; (6) it obviates need for anterior release; (7) it provides more accurate assessment of curve flexibility; and (8) it aids in

determination of lowest instrumented vertebra. **Purpose:** To determine the efficacy and complications associated with the use of intraoperative skeletal traction in scoliosis surgery. **Methods:** Twenty consecutive patients underwent posterior scoliosis correction from 2002 to 2005. Indications for traction included high magnitude (> 80°) curves, difficult to balance curves, associated pelvic obliquity or preventing excessive manipulation of the screws during correction in older patients. Bilateral distal femoral traction pins were used in patients with a level pelvis. Patients with neuromuscular scoliosis with pelvic obliquity underwent unilateral traction to level the pelvis and correct the deformity. Following general anesthesia, traction was applied using supracondylar femoral pin(s) with a maximum of 50% of the patient's body weight. Counter-traction was applied with Gardner Wells tongs with a maximum weight of 30 lbs. Preoperative, intraoperative and postoperative radiographs were assessed. No patients underwent anterior releases. **Results:** Main thoracic curves (MT) 74° (59–107°) corrected a mean of 32.7° (15–51°) with traction compared with 41.3° (15–78°) at final follow-up. Thoraco-lumbar/lumbar (T/L-L) curves, corrected a mean of 31.3° (17–46°) with traction compared with 31° (18–46°) at final follow-up. Intraoperative traction films had greater correlation with final correction compared with preoperative bending films. Pelvic obliquity and coronal balance greatly improved in our group of neuromuscular patients (n = 6). Traction-related complications included numbness around the medial knee in 1 patient. There were no cases of major neurologic injury. **Conclusion:** Traction is a safe and effective method to assist intraoperative correction of scoliosis and to predict the degree of correction that may be achieved by surgery. Intraoperative traction maximizes posterior scoliosis correction, obviating the need for anterior release. It facilitates correction of coronal imbalance and pelvic obliquity in patients with neuromuscular scoliosis.

Score distribution and discriminative validity of quality of life scores in patients with idiopathic scoliosis. ***E. Parent, M. Moreau, J. Mahood, D. Hill, E. Lou, J. Raso.*** **Capital Health — Glenrose Rehabilitation Hospital, Edmonton, Alta.**

Objective: To determine score distribution and discriminative validity of the Scoliosis Research Society-22 (SRS-22) questionnaire in patients with idiopathic scoliosis. **Method:** The SRS-22 quality of life questionnaire was administered to 171 scoliosis clinic patients (149 female, 22 male; age 15.1 ± 1.9 yr, < 20 yr) and 88 orthopedic office patients (< 20 yr: n = 46, age 15.8 ± 2.2 yr; > 20 yr: n = 42, age 34.2 ± 12.6 yr). The questionnaire consists of 22 questions assessing 5 domains (1 = worst, 5 = best): function, pain, self-image, mental health and treatment satisfaction. Differences between age, gender and treatment subgroups were assessed using analysis of variance (ANOVA). **Results:** The majority of the patients scored 4 or higher on most subscales: function (78%), pain (65%), mental health (60%), management (52%) but not self-image (40%). The proportion of patients scoring at the top of the scale was > 14% for the function, pain and management domains. In adults, function scores were significantly higher for patients just prescribed a brace than after surgery. Adolescents' pain scores were better (0.9) than adults', and brace wearers had better pain scores (0.9+) than patients planning or having had recent surgeries. The self-image of adolescents wearing a brace was higher than for those planning surgery (0.9). The self-image for adolescents with past surgery (> 1 yr) was higher than for those under observation (0.5), planning (1) or after recent surgery (0.7). Such differences were not found among adults. Mental health and management scores did not differ significantly between subgroups. **Conclusion:** Scores concentrated around the higher values of each SRS-22 domain, suggesting the questionnaire may not be sensitive to improvements. The pain, function and self-image scales showed limited evidence of discriminative validity.

The reliability of Cobb-angle measurement using digital radiographs versus a Web-based viewing system. ***J. Reed, D. Parsons, D. Kaura, G. Marshall, K. Thomas.*** **University of Calgary Spine Program, Division of Orthopedic Surgery; and Department of Radiology, University of Calgary, Alberta Children's Hospital, Calgary, Alta.**

Objective: To define the interobserver and intraobserver reliability between Cobb angles measured using hard-copy digital radiographs and a Web-based viewing system (WBVS). **Design:** Inter- and intraobserver reliability study. **Methods:** Twenty-six consecutive patients from an outpatient orthopedic clinic were identified. All patients had a diagnosis of idiopathic or neuromuscular scoliosis. Four reviewers measured 2 Cobb angles on each patient using both hard-copy digital radiographs and the Web-based viewing system. These measurements were repeated 2 weeks later. The primary outcome measure was the agreement between the radiographic and WBVS measurements of Cobb angle. Secondary outcomes included the interobserver reliability among the 4 reviewers for each technique and the intraobserver (test–retest) reliability. **Results:** The Pearson correlation coefficient between digital film and the Web1000 system was excellent (0.925). The limits of agreement between these 2 techniques were between –12.52 and 12.24. **Conclusions:** There was excellent correlation in the measurement of Cobb angles between hard-copy radiographs and the WBVS. The agreement of these 2 techniques however is not within an acceptable range for clinical practice. Film and Web1000 techniques are not interchangeable for the measurement of Cobb angles. One technique must be consistently used to monitor scoliotic curves.

Spinal adverse events grading system: validation and interobserver reliability. ***Y.R. Rampersaud, M.A. Neary, E.R.P. Moro, K. White.*** **Division of Orthopaedic Surgery; Division of Neurosurgery; and Spinal Program, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, University of Toronto, Toronto, Ont.**

Objective: The purpose of this study was to validate and evaluate the interobserver reliability of a locally developed grading system for adverse events (AE). **Methods:** AEs were graded as I (none/minimal treatment, minimal effect [< 1–2 d] on length of stay [LOS]), II (requires treatment and/or increases LOS [2–7 d] and no long-term sequelae), III (requires treatment and/or increases LOS [> 7 d] with long-term sequelae

[> 6 mo]) and IV (death). Validation (is the form capturing the AEs) of the grading system was performed using the hospital chart (current gold standard) compared with the grading system from 200 randomly selected patients in whom the grading system was prospectively used (n = 200/837 total). Interobserver reliability was assessed in 30 consecutive patients using 3 raters (staff, fellow and resident) who independently completed the AE form for the same AE. **Results:** Compared with the chart, the AE form displayed substantial agreement for number (70%; weighted kappa [wK] = 0.60) and type (75%; wK = 0.67) of AE. The prospectively administered form reported a higher number of surgical AEs (43 v. 30). The interobserver reliability was near perfect (kappa = 0.8) for the actual grade of AE and moderate (kappa = 0.5) for the criteria behind the grading (i.e., AE alone or AE effect on LOS or both). **Conclusion:** The results of this study show that the proposed AE grading system is valid and very reliable for capturing and grading AEs. Utilization and subsequent validation by other centres is required.

Multimodality evoked potential monitoring for intradural spinal cord lesions of the cervical and thoracic spine: correlation of intraoperative changes with surgical decision making and postoperative outcomes in a prospective series of 22 cases.
F. Vincent, M. Fehlings. **Toronto Western Research Institute, Krembil Neuroscience Centre, University of Toronto, Toronto, Ont.**

Objective: We hypothesized that changes in intraoperative motor and somatosensory evoked potential responses during surgery for intradural cervical and thoracic spinal lesions correlate with postoperative neurologic changes and influence intraoperative surgical decision making. **Methods:** Twenty-two patients undergoing resection of cervical and thoracic spinal lesions over a 48-month period were monitored with motor (MEP) and somatosensory evoked potential (SSEP) monitoring. We prospectively examined the relationship among intraoperative monitoring findings and pre- and postoperative neurologic examinations. **Results:** Twenty-two patients (7 intramedullary lesions, 12 extramedullary lesions, 1 syringomyelia and 1 transdural cord herniation were included in the study and followed postoperatively for 12 months. The correlation between MEP/SSEP changes and motor grade loss on preoperative and postoperative assessments revealed 3 true-positive and 19 true-negative MEPs and 1 true-positive and 19 true-negative SSEPs. Specificity was 100% for both MEPs\SSEPs, and sensitivity was 100% and 33% for MEPs and SSEPs, respectively. Positive predictive value (PPV) and negative predictive value (NPV) were 100% and 100% for MEPs, and were 100% and 90% for SSEPs. The accuracy of MEP and SSEP were 100% and 90%, respectively. **Conclusion:** These results demonstrate good sensitivity, specificity, PPV and NPV for MEPs. MEP monitoring accurately predicts postoperative decreases in neurologic motor function and provides additive information to SSEPs.

Photodynamic therapy (PDT) of vertebral metastases: tissue pharmacokinetics of photosensitizers in a rat model.
M.K. Akens, A.J. Yee, B. Wilson, S. Burch, S.K. Bisland. **Sunnybrook & Women's College Health Sciences Centre, University of Toronto; and Ontario Cancer Institute, Toronto, Ont.**

Purpose: Vertebral metastasis after breast cancer causes pain and can lead to spinal instability and/or paralysis. Radiation therapy has known limitations, and there is interest in biologic therapies that can reduce tumour burden. Previous published preclinical studies have supported the feasibility and efficacy of potentially applying PDT locally to the spine using a minimally invasive surgical approach adapted from the techniques of vertebroplasty/kyphoplasty (*J Biomed Opt* 2005;10:034011; *Semin Oncol* 1994;21[6 Suppl 15]:15–9 and 20–3; *Neurosurgery* 1991;29:688–95). Such an adjuvant approach to vertebroplasty/kyphoplasty can be an adjunct in ablating tumour in addition to affording spinal stability. PDT efficacy requires the administration of a photosensitizer drug followed by subsequent drug activation by wavelength-specific light. The study purpose was to establish the pharmacokinetic profiles for 2 photosensitizers to determine the optimal drug–light interval for vertebral PDT. Dependent on drug–light interval, benzoporphyrin derivative monoacid ring A (BPD-MA) has been shown to elicit PDT effect through predominantly vascular effects while 5-aminolevulinic acid (5-ALA) induces endogenous protoporphyrin IX production and demonstrates predominant cellular effects. There are theoretical considerations to the use of 5-ALA in neural tumour tissue selectivity, however, photosensitizer drug effects for this application in the spine has not been extensively evaluated. **Methods:** Human carcinoma cells (MT-1), transfected with the luciferase gene, were injected intracardically at a concentration of 2 ∞ 106 cells in 4- to 6-week-old female athymic rats. Fifteen days after cell injection, the rats received intraperitoneal injection with luciferin (60 mg/kg). Tumour-positive rats identified by bioluminescence were allocated to different time point and photosensitizer groups. After sacrificing, tissue samples were harvested and analyzed for photosensitizers BPD-MA or 5-ALA–induced protoporphyrinIX (PpIX) content by fluorescence (*J Photochem Photobiol B* 1997;39:229–35). The results were evaluated using analysis of variance (ANOVA).

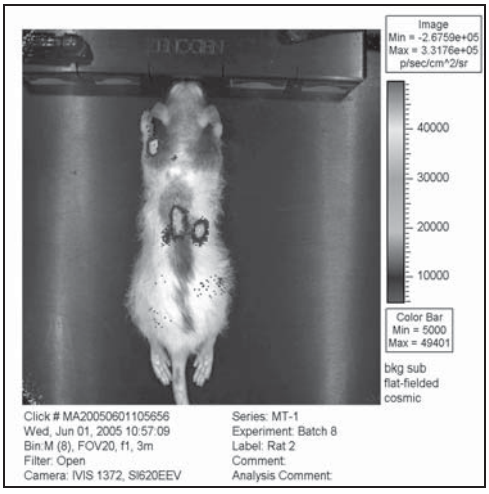
Experimental groups

Photosensitizer	Dose, mg/kg	No. patients: Tumour$^+$	No. patients: Tumour$^-$	Time-points
BPD-MA	2	27		15 min, 1 h, 3 h, 24 h
BPD-MA (control group)	2		12	
5-ALA/PpIX	200	19		2 h, 4 h, 6 h
None (control group)		3		
None (control group)			3	

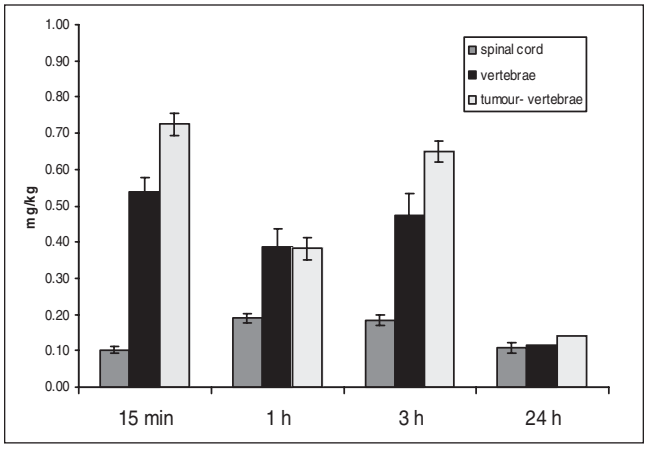
5-ALA = 5-aminolevulinic acid; BPD-MA = benzoporphyrin derivative monoacid ring A; PpIX = protoporphyrin IX.

Results: In the BPD-MA group, the highest concentration was found in the liver, followed by the kidney, and the lowest concentration was present in the spinal cord. The overall difference between spinal cord and surrounding vertebrae in tumour-

bearing rats was statistically significant ($p < 0.0001$). The greatest difference was observed 15 minutes after photosensitizer injection. In the 5-ALA group, the highest PpIX concentration was observed in the liver and kidney, followed by the spinal cord. There was no significant ($p > 0.05$) difference in PpIX concentration between spinal cord and vertebrae.



Bioluminescence image of a tumour-bearing rat. The coloured areas represent the luciferase transfected MT-1 carcinoma cells.



Tissue distribution of photosensitiser BPD-MA in tumour-bearing rats in spinal cord and vertebrae ($n = 7$ per group).

Conclusions: A clear vertebral–spinal cord difference in photosensitizer concentration is desired to optimize vertebral PDT efficacy and to minimize a potential risk of damage to adjacent normal neural tissue. For BPD-MA, drug concentration 15 minutes following injection was 5-fold higher in the surrounding vertebrae when compared with the spinal cord. An appreciable difference was not found for 5-ALA comparing spinal cord and adjacent vertebral PpIX concentration. The results of this study indicate that on the basis of drug pharmacokinetics, BPD-MA may be a better drug of 'initial choice' for vertebral PDT, and a drug–light interval of 15 minutes appears to be the optimal time point.

Acknowledgements: Canadian Breast Cancer Foundation, Ontario chapter.

Friday, March 24, 2006

The quality of 'quality of life' publications in spinal surgery. *J. Street, C. Fisher.* Combined Neurosurgical and Orthopaedic Spine Division, UBC Department of Orthopaedic Surgery, Vancouver General Hospital, Vancouver, BC.

Introduction: 'Quality of life' (QOL) measurement has almost become a prerequisite for the assessment of any therapeutic intervention. This recent development is reflected in an explosion in the number of published articles proposing to investigate 'quality of life' issues in surgical patients. Our study examines the trends in 'quality of life' articles in spinal surgery publications, specifically investigating if this recent enthusiasm is paralleled with the appropriate 'quality' of these articles. **Methods:** Six major journals related to spinal surgery were chosen: *Spine*, *Journal of Spinal Disorders & Techniques*, *European Spine Journal*, *Journal of Neurosurgery-Spine* and *Journal of Bone & Joint Surgery*, British and American editions. All the abstracts for the years 1999–2003 inclusive were examined, and any original articles proposing to measure quality of life, clinical or functional outcome, patient satisfaction or efficacy of a surgical procedure were chosen for inclusion. The articles were then scored according to the Gill and Feinstein criteria (*JAMA* 1994;272:619–26) as well as the Velanovich criteria (*J Am Coll Surg* 2001;193:288–96) for evaluating the 'quality' of an article relating to 'quality of life' measurement. **Results:** Of 1520 abstracts read, 348 articles were suitable for inclusion. In 2003, 37% of all articles proposed to measure 'quality of life' compared with 22% in 1999. A QOL instrument was used in 17% of studies in 1999 and only 11.5% of studies in 2003. The use of disease-specific measurements increased from 29% to 59% over the study period. Seventy-eight percent of measurements were validated in 2003 compared with 50% in 1999. There was no statistical difference in number of appropriate measures used over the study period. In 2003, 96% of articles were statistically 'sound' compared with only 52% in 1999. Only the Gill and Feinstein criteria 2 and 3 showed any significant improvement over the study period. **Conclusions:** Overall, the 'quality' of 'quality of life' articles published in the major spinal journals has not significantly improved despite the increase in the number of articles published.

Does the use of a minimal-access posterior muscle-splitting approach reduce acute postoperative pain? *M. Angelini, A. Al Belooshi, W. Latham, M.A. Bernstein, S.J. Lewis, Y.R. Rampersaud.* Division of Orthopaedic Surgery; Division of Neurosurgery; and Spinal Program, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, University of Toronto, Toronto, Ont.

Objective: The primary objective of this study was to assess the effectiveness of a minimal access (MA) paraspinal muscle–splitting approach in reducing acute perioperative pain. **Methods:** A retrospective review of perioperative data (demographics, pain, analgesic use, procedure time, blood loss, adverse events and total length of postoperative stay [LOS]) was performed in patients undergoing this approach

(MA) for 3 different lumbar procedures. These patients were compared with comparable control groups undergoing the same procedures using a conventional midline open exposure. **Results:** Procedures assessed: microdiscectomy (MD) (n = 95 MA, n = 105 open), decompression alone (D) (n = 30 MA, n = 37 open) and decompression + instrumented interbody fusion (DF) (n = 20 MA, n = 20 open). Comparatively, the subgroups were statistically equal. Acute postoperative pain (visual analog scale [VAS]), total anesthetic time, estimated blood loss (EBL) and total LOS were reduced in all 3 MA versus open groups.

Measurement of acute perioperative pain according to surgical approach

	VAS		Operative time, min.		EBL, mL		LOS, d	
Procedure	MA	Open	MA	Open	MA	Open	MA	Open
MD	3.5	6.1*	136	163*	Not assessed		0.18	0.21*
D	1.4	4.4*	154	179*	63	227*	2.6	4.7*
DF	4.7	5.6*	345	380	307	1374*	4.1	6.8*

D = decompression alone; DF = decompression + instrumented interbody fusion; EBL = estimated blood loss; LOS = length of postoperative stay; MD = microdiscectomy; VAS = visual analog scale.
*$p < 0.05$.

In addition, total analgesic use was reduced in the MA -MD, -D and -DF groups by 40%, 50% and 25%, respectively. Perioperative adverse events (AEs) were similar between the MD and D groups, however there were less AEs in the MA-DF group (3 v. 8). **Conclusion:** The results of this retrospective study (with a good sample size and statically homogenous groups) suggest that the use of a minimal-access muscle-splitting approach leads to less perioperative pain, analgesic use, blood loss and LOS without increasing the total average anesthetic time.

Correlation of MR findings with neurologic outcome in patients with acute cervical traumatic spinal cord injury: a prospective study in 103 consecutive patients.

F. Miyanji, J. Furlan, B. Aarabi, M. Fehlings. **Departments of Orthopaedic and Neurosurgery; Spinal Program, Toronto Western Hospital, Toronto, Ont.; and Department of Neurosurgery, University of Maryland, College Park, Md.**

Introduction: This multi-centre study examines whether quantitative MRI assessments after spinal cord injury (SCI) correlate with patients' neurologic status and are predictors of outcome at long-term follow-up. We hypothesized that the severity of cord compression and the extent of hemorrhage/edema would be independent predictors of neurologic outcome after SCI. **Methods:** Clinical data and MRI studies from 103 consecutive patients with traumatic cervical SCI were collected prospectively. Outcome measures included American Spinal Injury Association (ASIA) grade at hospital admission and at follow-up. An independent observer analyzed mid-sagittal MRI scans and determined the maximum spinal cord compression (MSCC) and maximum canal compromise (MCC). MRI scans were also evaluated to assess other potential prognostic qualitative parameters. **Results:** Most patients had incomplete SCI (46.7%). Complete SCI (ASIA A) was associated with a more significant MSCC at admission (p = 0.004) and at follow-up (p = 0.002). This difference was statistically significant from those with incomplete injuries (ASIA B–D) and neurologically intact patients (ASIA E). There was no significant difference in MCC among the 3 groups at admission (p = 0.107) and at follow-up (p = 0.231). The presence of hemorrhage and edema were more common in patients with ASIA A SCI. The extent of MSCC and the presence of hemorrhage were predictors of poor outcome at long-term follow-up. **Conclusions:** MRI is a useful tool in prognosticating the potential for neurologic recovery. More significant MSCC or the presence of hemorrhage, observed at admission, carry a poorer prognosis. The extent of the spinal cord compression (MSCC) is more reliable in predicting the neurologic outcome of patients than is the presence of canal stenosis.

Inhibition of the p75 neutrophin receptor does not protect against cell death at the injury site and worsens functional outcome after a clinically relevant compression model of spinal cord injury.

G.K.T. Chu, M.G. Fehlings. **University Health Network, Division of Neurosurgery, Toronto Western Research Institute, Krembil Neuroscience Center, University of Toronto, Toronto, Ont.**

Introduction: Apoptotic cell death plays an important role in spinal cord injury (SCI). Recent studies show that deletion of the p75 neurotrophin receptor may protect against apoptosis after a partial transection SCI. However, transection injuries are not common in humans compared with compression injuries. Therefore, we tested if p75 inhibition is neuroprotective after a clinically relevant compressive SCI. **Methods:** SCI was induced in p75-knockout and wild-type mice using a clip (Fejota) calibrated to a closing force of 8.4 g. The cord was compressed at the T6 level for 1 minute. Three and 7 days after injury, the cord was extracted for immunoblotting of caspase-9 and caspase-3. Animals were sacrificed at 7 days for terminal deoxynucleotidyl transferase mediated dUTP nick end labelling (TUNEL) counts at the injury site. For functional recovery, the animals were assessed with a modified Basso, Beattie and Breshnahan (BBB) locomotor rating scale. **Results:** The knockout mice had decreased levels of cleaved caspase-9. However, at 7 days, there was no difference in the levels of cleaved caspase-3 between either group. In contrast, the wild types had a greater BBB score (8.75) than the knockouts (6.42) at 8 weeks. Similarly, the wild types had a decreased number of TUNEL-positive cells compared with knockouts (12.1 ± 5.8 v. 36.8 ± 10.3). **Conclusions:** Surprisingly, our results indicate that inhibition of the p75 receptor is not neuroprotective after a compressive SCI. In fact, it is detrimental to recovery as indicated by the BBB scores. It is possible that alternate cell death pathways (Fas) may take precedence if p75 is inhibited or perhaps the prosurvival aspects of p75 are more important than the proapoptotic aspects after SCI. In conclusion, it appears that the role of the p75 receptor after SCI may be multi-faceted and cell death or survival may depend on the type of injury sustained.

Patient-oriented outcome after operation of cervical single-level radiculopathy: a randomized comparison of discectomy without fusion, discectomy with intervertebral fusion and discectomy with intervertebral fusion plus plating. ***J.C. Xie, R.J. Hurlbert, S.J. DuPlessis.* University of Calgary Spine Program, Calgary, Alta.**

Objectives: The purpose of this study was to assess clinical and radiographic outcomes in patients with single-level cervical radiculopathy after discectomy without fusion (ACD), discectomy with intervertebral fusion (ACDF) and discectomy with intervertebral fusion and plating (ACDFI). **Background:** A number of studies have attempted to address the need for interbody fusion after anterior cervical discectomy for radiculopathy. However, there is a paucity of patient-based data that quantitate the degree of pain relief or quality of life during the postoperative period. **Methods:** Forty-two consecutive patients with cervical radiculopathy who failed medical management were randomized to 1 of 3 treatment groups: ACD, ACDF and ACDFI. Indices including symptoms, work status, Short Form-36 (SF-36), McGill pain scores and anteroposterior/lateral flexion/extension radiographs were obtained preoperatively and throughout the 2-year follow-up period. **Results:** Twelve patients were randomized to ACD, 15 to ACDF and 15 to ACDFI, respectively. At 1-year follow-up arm pain was completely absent in 92% of ACD patients, 93% of ACDF patients and 100% of ACDFI patients, respectively ($p > 0.05$). There were no inter-group differences during the follow-up period with respect to neck pain, interscapular pain or arm pain ($p > 0.05$). SF-36 scores demonstrated a dramatic postoperative improvement followed by further gradual improvement in both physical and mental components as well as the other subscale scores during follow-up in all groups. Eighty-three percent bony union occurred in ACD patients compared with 93% of ACDF patients and 100% of ACDFI patients ($p > 0.05$). Instability was not demonstrated in any patient. A more kyphotic sagittal alignment was noted in 75% of the ACD patients postoperatively compared with 17% preoperatively. There was no change in sagittal balance in the ACDF or ACDFI groups. **Conclusions:** Patient selection and surgical decompression remain the key to achieving desirable clinical outcomes following cervical discectomy for radiculopathy. Within a 2-year follow-up interval the technique of reconstruction plays no role in clinical results. However, ACD alone results in loss of lordosis and kyphotic deformity compared with ACDF and ACDFI.

Management of multilevel cervical spondylotic myelopathy (CSM) by posterior decompression and instrumented fusion: indications, results and outcomes in a series of 93 cases. ***A. Kulkarni, E. Massicotte, J. Furlan, M. Fehlings.* Division of Neurosurgery, University of Toronto; Spinal Program, Krembil Neuroscience Centre, University Health Network, Toronto, Ont.**

Introduction: While cervical laminectomy and instrumented fusion is an increasingly used treatment option for cervical myelopathy, surprisingly little outcomes data are available regarding this approach. **Objective:** We undertook a retrospective cohort analysis of a consecutive series of 103 cases of patients who underwent cervical laminectomy and instrumented fusion for CSM. **Methods:** The Nurick scale was the principal outcome measure used to assess neurologic improvement. Sex, age, diabetes, hypertension, postoperative complications and smoking were considered potential covariates. The Charlson Index was used to quantify comorbidities. Data were analyzed using Fisher's exact test, Mantel–Haenszel χ^2 test, Mann–Whitney U test and multivariate analysis. **Results:** Ten patients were excluded from the analysis due to lack of follow-up data, the co-existence of cervical dystonia or combined anterior/posterior surgery. There were 2 perioperative deaths (2%). Ninety-one patients had complete Nurick data (59 men, 32 women; ages 33–88 yr). At final follow-up (mean 17 mo), 50, 34 and 5 patients had a better, unchanged or worsened Nurick score, respectively. Postoperative complications occurred in 22.8% of the patients. Diabetics had worse baseline and follow-up Nurick scores than non-diabetic patients ($p = 0.022$). Using multivariable analysis, the postoperative Nurick score adjusted for baseline was not significantly affected by sex, age, diabetes, hypertension, smoking and postoperative complications ($p = 0.467$). The mean Charlson Index was not significantly associated with worse outcomes based on Nurick scores. **Conclusions:** Despite significant comorbidities in these patients, multilevel laminectomy and instrumented fusion improves or stabilizes the disability caused by CSM in 95% of patients.

Radiographic outcome of pedicle screw fixation for upper thoracic spine (T1–T5) fractures. ***S. Singh, C. Fisher, R. Mobbs, M. Boyd, B. Kwon, S. Pacquette, M. Dvorak.* Division of Spine, Department of Orthopaedics, University of British Columbia; the Combined Neurosurgical and Orthopaedic Spine Program, Vancouver Hospital and Health Sciences Centre, Vancouver, BC.**

Study design: An analysis and cross sectional outcome of patients prospectively entered into a spine trauma database with an unstable upper thoracic spine (T1–T5) fracture that underwent pedicle screw fixation. **Objective:** The primary outcome of this study was to determine the efficacy of pedicle screw fixation to achieve and maintain reduction of unstable upper thoracic spine fractures (T1–T5). Secondary outcomes included generic health-related quality of life at 1 year after surgery and early and late postoperative complications. **Background:** The use of pedicle screws for stabilization of unstable thoracolumbar and lumbar fractures has become the standard of care over the last decade. Its theoretical biomechanical advantages include 3-column control of vertebral segments and fixation of a vertebral segment in the absence of intact posterior elements. Transpedicular screw fixation in thoracolumbar and lumbar spine has been used and evaluated by various workers but, until recently, a study evaluating the efficacy of posterior pedicle screw instrumentation in upper thoracic spine fractures has not been reported. In addition, concerns regarding accuracy of screw placement should be greatest in the upper to middle thoracic vertebrae (T4–T7), where pedicle diameters are smallest and proximity of the great vessels is nearest. **Methods:** A retrospective analysis and cross-sectional outcome of patients prospectively entered into

a spine trauma database. All patients with an unstable upper thoracic spine (T1–T5) fracture who underwent pedicle screw fixation (n = 37) at Vancouver General Hospital (VGH) between August 1997 and July 2004 were included in this study. Preoperative CT scans (reformatted images in sagittal plane) were used to determine the preoperative kyphotic deformity by measuring the Cobb angle. The readings were compared with those obtained from immediatly after surgery and the latest follow-up x-rays/CT scans. Patient charts, operative notes and postoperative follow-up examinations were reviewed. Patients were mailed packages containing the Short Form (SF)-36 by an independent study coordinator. **Results:** Twenty-seven of 35 patients were available for follow-up. Of the 27 patients, 23 were male and 4 were female. The average age of the patients was 39.9 years (range 16–73 yr). In all, 251 pedicle screws were passed between T1 and T8. The mean true preoperative kyphotic deformity in our series was 18.2°. The mean true postoperative kyphosis and true kyphosis deformity at 1 year after surgery were 8.7° ($p < 0.0005$) and 10.1°, respectively. The mean SF-36 physical health score (PCS) was 35.89, while the mental component score (MCS) was 56.43. There were no intraoperative vascular or neural complications. Six patients underwent implant removal at an average of 113.5 weeks (range 32–240 wk) post surgery, 5 for the reason of local pain and 1 for persistent deep wound infection. **Conclusion:** Pedicle screw fixation for reduction and stabilization of upper thoracic spine fractures is a safe and efficacious technique provided it is performed by competent hands after meticulous preoperative planning. Preoperative CT scan is essential to identify the fracture pattern and study the pedicle anatomy at each level of proposed fixation.

Outcome of long fusions to L5 in an adult deformity population. ***G. Swamy, S. Boyd, S. Berven, V. Deviren, S.S. Hu, D.S. Bradford.*** **University of Calgary, Calgary, Alta.; University of California, San Francisco, Calif.**

Study design: Retrospective clinical and radiographic analysis of long fusions to L5 in an adult population. **Hypothesis:** Terminating long fusions at L5 in an adult deformity population is an effective procedure, yielding good long-term outcome in a majority of patients. **Objectives:** To document clinical and radiographic outcome, complication rate and survivorship of long fusion constructs (> T12) stopping at L5. **Methods:** We reviewed a consecutive series of patients with long fusion constructs ending at L5 from the University of California San Francisco orthopedic spinal disorders surgical database from 1991 to 2000. Nineteen patients were examined with complete radiographic and clinical data sets and more than 5 years follow-up. The indications for long fusion constructs were adult scoliosis in 16, post-irradiation deformity in 1 and post-laminectomy deformity in 2. There were 17 women and 2 men, with an average age of 50 years (range 25–73 yr). Twelve patients underwent 1–3 previous operations, while 7 underwent primary procedures. Five underwent posterior-only procedures, while 14 underwent circumferential fusions. Seven patients have since undergone extension of fusion to the sacrum and comprised group II; the remaining 13 patients comprised group I. There was no association between preoperative radiographic characteristics of the deformity and outcome (coronal/sagittal plane imbalance, curve magnitude). Specifically, the lumbosacral disk space appearance (disk height, lordosis) was similar in both groups preoperatively. Presence of postoperative degenerative changes at the lumbosacral disk did not correlate with outcome. Group II underwent revision at an average of 35 months (range 5 mo–7 yr 5 mo). Indications for revision included sagittal imbalance and adjacent segment degeneration. Revision operations were generally large in magnitude, with 6550 mL of blood loss and 9.5 hours operative time. Patients in groups I and II had similar scores in Scoliosis Research Society, Oswestry Disability Index and SF-12 outcome measures. Some patients reported a change in functional status after revision to sacrum, including change in gait pattern, loss of twisting and bending ability, and more difficulty with perineal care. At least 4 patients in group I are being considered for revision. **Conclusion:** In conclusion, long fusions to L5 in an adult deformity population can yield acceptable results more than 5 years after surgery. Although of smaller magnitude than primary fusions to sacrum, stopping at L5 is associated with a significant revision rate. There may be a functional loss associated with fusion to sacrum. Despite the potential larger morbidity, long thoracolumbar fusions may yield a more predictable result if extended to the sacrum.

Saturday, March 26, 2006

Trends in lumbar spinal fusion and surgeon factors in spinal surgery. ***S. Bederman, H.J. Kreder, I. Waller, J.A. Finkelstein, M. Ford, A. Yee.*** **The Spine Program, Division of Orthopaedic Surgery, Sunnybrook & Women's College Health Sciences Centre, Toronto, Ont.**

Rationale: Significant recent increases in lumbar fusion rates have been observed in the United States. Less is known regarding the Canadian experience. It was the study purpose to evaluate recent trends in lumbar fusion and surgeon factors that may influence outcome. **Design:** Longitudinal follow-up of lumbar surgical procedures for spinal stenosis/spondylosis using administrative Canadian Institute for Health Information (CIHI)/Ontario Ministry of Health and Long-Term Care (OHIP) databases. Data were gathered on patient–hospital encounters between Apr. 1, 1995, and Dec. 31, 2001. Spinal reoperation rates were evaluated (6 wk, 1 and 2 yr until maximal follow-up). Trends in spinal fusion including surgeon variables as predictors of patient reoperation were evaluated using bivariate, multivariate and survival analysis. **Results:** Six-thousand, one-hundred and twenty-eight patients were identified (4200 decompressive procedures, 1928 fusion). Proportionally more fusions have been performed over the study period when compared with decompressive procedures (1:2.6 in 1995 v. 1:1.5 in 2001). Surgeon specialty and volume influenced the proportion of fusions performed ($p < 0.0001$). There was a higher reoperation rate for decompressive procedures at 2 years (odds ratio 1.4) but no difference in survival analysis to 10 years. There was no difference in procedure type or surgeon specialty for reoperation at 10 years. Low volume spinal surgeons had a higher rate of patient reoperations after adjusting for specialty (Hazards ratio 1.28). **Discussion:** There is wide variation in procedures between specialties and

surgeon volume. Surgeon specialty had little impact on reoperation. Better long-term survival was observed in high-volume spinal surgeons. Increasing trends in lumbar spinal fusion rates in Ontario over time are consistent with recent US observations. The efficacy of spinal fusion and the cost benefit of these procedures require ongoing study.

Is excessive bone formation associated with the use of rhBMP2 in minimal access PLIF/TLIF? ***V. Joseph, Y.R. Rampersaud.* Divisions of Orthopaedic and Neurosurgery, University of Toronto, Krembil Neuroscience Centre, Toronto Western Hospital, Toronto, Ont.**

Introduction: The use of rhBMP2 for interbody fusion is associated with excellent fusion rates. For posterior approaches, concerns regarding the formation of bone within the epidural space have been raised. The objective of this study was to assess the incidence and clinical sequelae of epidural bone formation after the use of rhBMP2 in minimal access interbody fusions. **Methods:** This study compared 2 groups (A: with BMP, $n = 23$ / B: without BMP, $n = 10$) of patients who had undergone instrumented posterior lumbar interbody fusion (PLIF) ($n = 10$) or transforaminal lumbar interbody fusion (TLIF) ($n = 23$ [$n = 4$-bilateral]) with a minimum 6-month postoperative CT. In all cases, local autograft and/or allograft was used. Clinical chart review and CT assessment for bone formation (intradiscal, annular/anterior longitudinal ligament/posterior longitudinal ligrament, epidural — canal/foramen — and beyond the spine) was independently performed. **Results:** Average clinical and CT follow-up was 13.0 and 7.9 months, respectively. From 33 patients, 36 levels (3 patients had 2 level procedures) were assessed. Bridging bone was seen in all but one level. Bone formation within the disc, to the outer rim of the annulus, canal, foramen and beyond the spine was seen in 100%, 44.4% ($n = 11$ group A, $n = 5$ group B), 6% ($n = 1$ group A, $n = 1$ group B), 11% ($n = 4$ group A) and 0% of levels, respectively. Foraminal bone formation was only seen in the BMP-TLIF group. No clinical sequelae were associated with epidural bone formation. **Conclusion:** Although the use of rhBMP2 is associated with a higher incidence of epidural bone formation, there does not seem to be any associated clinical sequelae.

Biomechanical analysis of short posterior spinal instrumentation in bridge-type fixation for spinal fracture management. ***C. Richards, D. Giannotsios, T. Steffen, P. Jarzem, R. Reindl, V. Arlet, J.A. Ouellet.* Orthopaedic Research Laboratory, McGill University, Montréal, Que.**

Posterior osteosynthesis of thoracolumbar fractures has been shown to settle into kyphosis if the classic parallel screw type fixation is used. **Purpose:** The purpose of this study was to determine, via computational and biomechanical testing, if a divergent pedicle screw orientation in the sagittal plane would provide more stable posterior spinal fixation. **Methods:** The classic tension band (T-B) construct consists of pedicle screws inserted, parallel to each other in the sagittal plane, in the vertebra above and below the fractured vertebra. The bridge (B) construct consists of pedicle screws inserted divergent to each other in the sagittal plane, anchoring in the subchondral bone of the vertebral body end plates. We tested our hypothesis using 3 methods: finite element analysis (FEA); 6 synthetic models using the ASTM standard for corpectomy; and third, a human cadaveric model quantifying construct stiffness and ultimate failure load with a standard MTS machine. **Results:** All 3 modalities showed greater stiffness with the bridge-type fixation. The FEA calculated a construct stiffness of 21.6 N/mm for the T-B construct compared with 34.1 N/mm for the B construct. Testing of the synthetic model resulted in an average construct stiffness of 17.3 N/mm for T-B versus 20.6 N/mm for the B construct ($p = 0.015$). The same trend was seen with the cadaveric model with an average construct stiffness of 15.2 N/mm in the T-B construct compared with 18.4 N/mm for the B construct ($p = 0.012$). Ultimate failure load was found to be almost 50% greater for the B construct: 622 N versus 419 N ($p = 0.076$). **Conclusion:** Our testing revealed a significant biomechanical advantage for the divergent pedicle screw construct when compared with the classic parallel screw construct. This study shows that divergent screw fixation is significantly stronger and more fatigue resistant than parallel screw fixation in these various corpectomy models, and may off load the anterior column sufficiently to allowing it to heal in cases where the vertebral bodies are fractured. The added strength of this fixation may allow surgeons to avoid anterior column reconstruction in some thoracolumbar fractures.

Prospective clinical results of Actipore™ intervertebral fusion in a series of 40 patients with up to 3 years follow-up. ***P. Jarzem.* McGill University, Montréal, Que.**

Introduction: Actipore™ is a porous titanium nickelide with high porosity and mechanical properties similar to bone. No bone graft is required with this material. Animal studies have demonstrated that Actipore™ cages integrate more rapidly and completely than hollow titanium cages. **Methods:** Health Canada approval for the use of Actipore™ for intervertebral fusion was obtained in 40 patients from December 2002 until December 2005. The average age of the patients was 51 years: 66% were female, 34% were male. The indications for surgery were spondylolisthesis 54%, recurrent disc hernias 16% and post-discectomy syndrome 11%. Eighty-four percent were single-level and the remainder dual-level surgeries. Rectangular cages were used in 71% of the cases. Ninety-seven percent had supplemental fixation. Patients were evaluated prospectively with x-ray pain and outcome measures both before and after surgical implantation. **Results:** Average operative time was 194 minutes, average blood loss was 765 mL. Complications included CSF leak 13%, numbness 10%, cage displacement 3%, thromboembolic disease 5% and infection 3%. The average preoperative Oswestry was 53, and, at latest follow-up (average of 17 mo after surgery), the Oswestry was 19. No nonunions were recorded in this series. Supplemental fixation was with pedicle screws in 82%, translaminar facet screws in 10% and cervical plates in 5%. Only 1 device-related complication was noted, and that was in one of the early patients. In this patient, reoperation occurred at 1 month, but at 4 months the patient was back to work. No device breakage,

disintegration or pathologic subsidence was noted. A second surgery was performed in 2 other cases, 1 for wound dehiscence at 1 week and another for wound infection at 2 weeks postoperative. **Discussion:** When compared with other intervertebral cages, fusion rates, complication rates and patient outcomes are comparable to literature controls. Only 1 device-related complication was noted early in this case series. Actipore™ provides the added advantage of not requiring additional bone graft harvest or bone substitutes, while at the same time providing a satisfactory clinical union rate.

Complications of lumbar artificial disk replacement and revision strategies. ***F.E. Vigna, A. Cappuccino.***

Lumbar artificial disk replacement has a greater than 20-year history in Europe, however, its use in North America has been limited until recently. Highlighted by the United States Food and Drug Administration accepting the SB Charite III (Depuy Spine, Raynham, MA) in October 2004 as a medical device to be implanted in that country this technology has been gaining more acceptance in North America. Most of the complications of this procedure are approach related and identical to those of an anterior lumbar interbody fusion (ALIF). However, lumbar total disk replacement (TDR) appears to be a more technically demanding procedure and requires a more stringent patient selection than an ALIF. Most of these additional complications appear to be related to surgical technique or patient selection. While the surgical approaches for implantation are nearly identical, the TDRs require revision strategies that often differ from those of ALIFs.

In our series of over 250 SB Charite implantations we have performed 5 revision surgeries for a revision rate of < 2%. Three of these patients were revised secondary to acquired spondylolysis and 2 secondary to device displacement. All devices were implanted via a left retroperitoneal approach and revised via an alternative approach. All were revised safely, without intraoperative complications. As the technology becomes more widely used the proper patient selection, stringent adherence to intropeative technique and postoperative patient protocols are essential. For those few patients who require a revision anterior surgery the SB Charite can be successfully converted to anterior interbody fusion.

The learning curve of minimally-invasive lumbar microdiscectomy using a tubular retractor system. ***G. McLoughlin, D.R. Fourney.*** **Division of Neurosurgery, Royal University Hospital, University of Saskatchewan, Saskatoon, Sask.**

Objective: An appreciation of the learning curve of a new surgical technique is important for its safe integration into clinical practice. The objective of this study was to assess the learning curve for minimally-invasive lumbar microdiscectomy (MIM) using the METRx tubular retractor system. **Methods:** A prospective evaluation of a single surgeon's first 26 consecutive cases of MIM for radiculopathy secondary to single-level posterolateral lumbar disc herniation was performed. The learning curve was assessed using surgery time, rate of conversion to open procedure, and complication rate. Results were compared with a consecutive group of 26 patients with the same surgical indications who underwent standard lumbar microdiscectomy by the same surgeon. **Results:** The duration of surgical operating time decreased over the course of the study. With experience, operating time for MIM became slightly shorter than open discectomy. There was only 1 conversion to open discectomy (Case 2). The asymptote of the learning curve was about 15 cases. The rate of complications was low. Length of hospitalization was shorter for MIM, but discharge protocols for open microdiscectomy and MIM differed. **Conclusions:** The learning curve for MIM was demonstrated. Further assessment of this curve for a large group of surgeons is necessary before a randomized controlled clinical comparison of standard microdiscectomy versus MIM can be conducted.

Please note: This study was not supported by industry or any granting agency.

Outpatient spinal stenosis decompression using a modified lumbar laminoplasty technique: feasibility and early outcomes. ***A. Al Belooshi, S.J. Lewis, Y.R. Rampersaud.*** **Division of Orthopaedic Surgery; Division of Neurosurgery; Spinal Program, Krembil Neuroscience Centre, Toronto Western Hospital, University Health Network, University of Toronto, Toronto, Ont.**

Objective: The purpose of this study was to demonstrate the feasibility and early outcomes of 1- and 2-level lumbar decompression performed as an outpatient procedure. **Methods:** Retrospective review was performed comparing a modified lumbar "laminoplasty" (bilateral decompression from a unilateral approach) using a minimally invasive (MIS) technique (METRx™ tubular retractor system) to open laminoplasty (Open). **Results:** Sixty-seven patients with a minimum follow-up of 6 months were analyzed (Open: n = 37, follow-up 38.5 [17–60] mo; 1/2 level n = 17/20; grade I spondylolisthesis n = 16. MIS: n = 30, follow-up 24.5 [6–45] mo; 1/2 level n = 21/9; grade I spondylolisthesis n = 13; outpatients n = 20). There was no statistical difference between groups for demographic, diagnostic and imaging parameters. The MIS group demonstrated a statistically significant reduction (mean 24 min) in operative time, estimated blood loss (63 mL v. 227 mL), recovery room pain VAS scores (1.4 v. 4.4) and total analgesic requirements (50% reduction). Two patients from the MIS group required admission for observation following dural tears. The VAS and length of stay for the MIS inpatients (n = 10) versus Open was also reduced (VAS 1.0 v. 4.9; LOS 2.6 v. 4.7 d; p = 0.03). The groups were comparable in operative and postoperative adverse events. Clinical and radiographic outcomes have remained stable for the follow-up period. **Conclusion:** Outpatient decompression for 1- to 2-level spinal stenosis is feasible and efficacious. Both groups demonstrate the ability to safely perform decompression alone in the presence of grade I spondylolisthesis. The results of this study are provocative from a cost and resource utilization perspective.

Low-grade spondylolisthesis: how pelvic tilt and sacral slope interact with spino-pelvic balance. ***H. Labelle, T. Hresko, P. Roussouly, E. Berthonnaud.*** **Sainte-Justine University Hospital, Montréal, Que; Boston Chil-**

dren Hospital, Boston, Ma.; Centre des Massues; and Optimage, Group of Applied Research in Orthopedics, Lyon, France.

In a previous study, we reported that patients with spondylolysis and low-grade spondylolisthesis appeared to have increased pelvic incidence (PI) as well as a more vertically oriented L5–S1 intervertebral disc than normal subjects, suggesting that shear across the more vertical L5–S1 disc may underlie the etiology of spondylolysis when PI is high, while a "nutcracker" mechanism may be involved when PI is low. In order to validate these concepts, the standing posteroanterior and lateral spine radiographs from 208 patients with low-grade spondylolisthesis (mean age 19, range 15–44 yr) were digitized with a VIDAR scanner, and key landmarks were determined. A customized software was then used to measure geometric indices: PI, sacral slope (SS), pelvic tilt (PT), thoracic kyphosis (TK), lumbar lordosis (LL), L5 incidence (L5I) and L5–S1 extension angle (LSA). Data analysis with k means cluster analysis produced 2 distinct groups based upon pelvic tilt and sacral slope. The first group was found to have low means for both measures (mean PT of 11, standard deviation [SD] 7; mean SS of 45, SD 8), while the second group had high means for both measures (mean PT of 23, SD 8; mean SS of 56, SD 7). Significant differences between groups were found for L5I, LL and LSA. Since PI = PT + SS, this study confirms the existence of 2 distinct sagittal spino-pelvic configurations in these patients, supporting our hypothesis and highlighting the importance of studying localized lumbosacral spine disorders in the context of global alignment of the entire spine and pelvis.

Funding: This research was assisted by support from the Spinal Deformity Study Group. This research was funded by an educational/research grant from Medtronic Sofamor Danek.

CSS 2006 — Poster presentations

Giant cell ependymoma of the spine: case report of a thoracic spine lesion and review of the literature. ***M.F. Shamji, B.G. Benoit, G.H. Jansen*. Divisions of Neurosurgery and Anatomic Pathology, The Ottawa Hospital, Ottawa, Ont.**

Spinal ependymomas are slow-growing lesions that comprise the majority of primary spinal cord neoplasms. When surgical treatment is offered, the extent of tumour removal is the most significant prognostic factor for long-term survival. Unusual histological subtypes can make intraoperative diagnosis spurious, thereby possibly altering surgical approach from gross-total resection for ependymoma to debulking for high-grade astrocytomas.

We describe a 67-year-old woman with a thoracic spine intramedullary giant cell ependymoma. She initially presented with decreased lower extremity sensation leading to unsteadiness and an eventual fall. Physical examination revealed lower extremity hyperreflexia, ankle clonus, but no clear sensory level. Magnetic resonance imaging demonstrated a T1 and T2 hypointense, homogenously-enhancing lesion at T8, thought to be intramedullary, with extensive cephalad and caudal edema. Laminectomy at T8–9 afforded biopsy and gross total resection of the lesion that had a clear plane of cleavage with normal spinal cord. Intraoperative pathology suggested high-grade glioblastoma; but final section showed sporadic giant cells with marked pleomorphism, uniform immunofluorescence staining with both GFAP and CD99, and high proliferation index with MIB-1 stain. Electron microscopy showed "zipper-like" junctions. There were no detected genomic abnormalities consistent with glioblastoma.

We present this first reported case of thoracic spine giant cell ependymoma, surrounded by a scant literature yielding 1 case in the cervical spine and 2 cases in at the filum terminale. Although those cases had benign courses, ours demonstrates a high degree of proliferation making the malignant potential difficult to assess. Histology, immunofluorescence, and electron microscopy studies are illustrated.

Tranxenamic acid for hemostasis in the surgical management of metastatic tumours of the spine. ***D.A. Bednar, V.A. Bednar, A. Chaudhary, F. Farroukhyar*. Division of Orthopaedic Surgery; Faculty of Arts & Science; Department of Clinical Epidemiology & Biostatistics, McMaster University, Hamilton, Ont.**

Purpose: To assess the efficacy of tranxenamic acid in decreasing operative blood loss and the need for intraoperative transfusion in metastatic spine surgery. **Methods:** This is a retrospective study of sequential cohorts of metastatic spine patients undergoing intralesional tumour excision and concomitant instrumentation to stabilize the spine in the hands of a single surgeon. The majority of cases in both groups had surgery without preoperative tumour embolization as this service is only irregularly available in our centre. **Results:** Estimated operative blood loss, 1425 mL in the study group treated with tranxenamic acid and 1625 mL in controls not receiving the drug, was not significantly decreased. Both groups required a mean of 2 units of intraoperative transfusion. **Discussion:** Control of operative bleeding in metastatic spine surgery can be problematic and estimated operative blood loss approaching or exceeding patient blood volume is not uncommon. Optimum protocol includes routine preoperative angiographic tumour embolization to decrease lesion vascularity. In many centres appropriate radiographic expertise may not be always available, and these invasive adjunctive procedures are themselves not without risk. Noninvasive prophylaxis of tumour bleeding has obvious desirable advantages but was unfortunately not achieved in this study.

Funding: No funding was received in support of this work.

Results of a biomechanically optimized lumbosacral fixation construct in adult spinal reconstruction. ***D.A. Bednar, N.R. Zabtia*. Division of Orthopaedic Surgery, McMaster University, Hamilton, Ont.**

Purpose: To review the clinical and radiographic results of a novel technique of aggressive lumbosacral fixation in adult lumbar reconstruction using transdiscal (sacrolumbar) L5/S1 screws and S2 pedicle screws. **Methods:** This is the retrospective report of a series of 23 osteopenic adult spine surgical patients requiring aggressive lumbosacral fixation in the repair of degenerative lumbar scoliosis with stenosis or spondylolisthesis. **Results:** Radiographic evidence of fusion was obtained in 19 cases (87%) at a mean follow-up of 12 months (range 6–24 mo). There were no neurologic complications relating to the sacrolumbar screws, but early in the series the right S2 screws of 2 patients were misplaced by protocol error and required reorientation because of S2 sciatica. Radiological translucency was found in one case (4.3%), and in 1 patient the entire implant construct was removed because of back pain without sciatica. **Discussion:** The described technique incorporates findings from several biomechanical studies of sacral osteology and sacral fixation to create a possibly optimized lumbosacral fixation construct without any requirement to cross the sacroiliac joint, without the cost and complications of iliac bolt reconstruction and eliminating any need for secondary anterior stabilization. The results of this study have shown that transdiscal lumbosacral screws can be safe and effective.

Lumbar interbody arthrodesis with the Prospace™ osteoconductive interbody implant and supplementary unilateral intertransverse arthrodesis using local bone harvested at decompression. Interobserver and intraobserver reliability in interpreting radiographic fusion. ***D.A. Bednar, A. Rabinovich, B. Toorani, S. Bajammal, P. Alexander, A. Franchetto*. Division of Orthopaedic Surgery, McMaster University, Hamilton, Ont.; University Hospital, Manama, Kingdom of Bahrain; Joseph Brant Memorial Hospital, Burlington,**

Ont.; Imaging Department, Hamilton General Hospital, Hamilton, Ont.

Purpose: To review the imaging results of a novel posterior lumbar interbody fusion (PLIF) construct using local bone graft for supplemental intertransverse arthrodesis, and to determine intraobserver and interobserver reliability in the radiographic assessment of these lumbar fusions. **Results:** Six experienced observers each made 2 separately blinded reviews of randomized radiographic images from a consecutive series of 43 adult patients who had had posterolateral lumbar interbody fusions at 62 lumbar motion segments performed with a unique osteoconductive lumbar interbody implant, allowing for 360° lumbar fusion without iliac bone graft harvest. All 63 instrumented motion segments were reviewed independently. Fusions were graded according to previously established radiographic criteria from the literature. Weighted kappa statistics were calculated from the resulting Microsoft Excel database and SPSS software. Intraobserver reliability was slight to substantial (kappa ranged from 0.13 to 0.76) and interobserver variability was only slight to moderate (kappa 0.19–0.52). Seniority or experience of the observers produced no trend to improved consistency in intraobserver reliability. **Significance:** The use of local autograft bone for intertransverse arthrodesis in this PLIF construct is supported, and simple radiographs may be adequate to assess the presence of lumbar fusion. **Discussion:** Plain radiograph analysis of lumbar fusion constructs, according to standardized criteria taken from the literature, was found to be moderately consistent. The use of local autograft bone for intertransverse arthrodesis in this PLIF application is supported.

Funding: No funding was received in support of this project.

Evaluating Web sites for adolescent idiopathic scoliosis (AIS) using the DISCERN. *S. Donaldson, D. Nicholas, A. Howard, J.G. Wright.* The Hospital for Sick Children, Toronto, Ont.

Purpose: AIS patients and their families need high quality information when making decisions about surgery. The purpose of this study is to assess the quality and content of scoliosis Web sites, specifically risks and benefits for operative and nonoperative patients. **Method:** Web-based resources were identified using health Web site search engines (e.g., Sympatico, www1.sympatico.ca; Yahoo Health, www.yahoo.com/Health/Children_s_Health). The DISCERN, a 16-item rating scale, was used to judge the reliability and quality of information about treatment choices. **Results:** Of 15 identified scoliosis Web sites, 6 were nonprofit organizations, 6 were commercial and 3 were hospital-based sites. Although 47% of Web sites (7/15) earned a score of 70% on the DISCERN, few specified sources of information, none were evidence-based and none had formally considered the needs of patients and families. As well, some Web sites integrate content product endorsement introducing a potentially confusing and biased mix of patient/parent info and industry promotion and benefit. None of the sites provided a mechanism for family support. **Conclusions:** Although there is a substantial need for family-oriented support and evidence-based information on scoliosis treatment, no Web site includes these essential features. **Significance:** A Web site that incorporates these areas has the potential to enhance the health care experience of adolescents undergoing scoliosis surgery.

Funding: This project was funded by the Zimmer Fund and Salter Chair.

A large 18-level non-traumatic spinal epidural hematoma associated with spinal metastasis from non-small cell lung cancer: a case report. *J. Matthews, K. Thomas.* University of Calgary Spine Program, Calgary, Alta.

A 57-year-old woman presented to the emergency department (ED) with acute non-dermatomal pain in both legs and urinary retention. She demonstrated grade 3 motor power in her lower extremities, decreased anal tone and numbness of the saddle area with perianal sparing. Three weeks earlier the patient had a bone scan and MRI for persistent back pain that was suggestive of diffuse neoplastic disease. At her ED presentation the primary source of her metastatic disease was still unknown.

At hospital admission her repeat MRI revealed a massive spinal epidural hematoma (SEH) extending from T1 to the sacrum with maximal cord compression at T8. The patient was started on dexamethasone and the spine service was consulted. Preoperative embolization of a sacral metastasis was followed by laminectomies of T8–T11 and evacuation of the hematoma. A transpedicular biopsy identified the primary neoplasm as non-small cell lung carcinoma.

On the first postoperative day, all motor and sensory functions had returned, and she was ambulatory without leg pain. Despite the extent of the hematoma, poor preoperative function and disseminated metastatic disease, the sensorimotor exam remained normal until her discharge. Three months postoperatively, the patient was neurologically intact apart from episodic bladder dysfunction.

This case is unique. The magnitude of this SEH is the most extensive in the literature. It is also rare for a non-traumatic SEH to be associated with malignant vertebral involvement (*Spine* 1998;23:2432-5). Full neurologic recovery was maintained despite the extent of her disease.

Routine histopathological examination of intervertebral disc specimens: a cost–benefit analysis. *A.S. Wu, D.R. Fourney.* Division of Neurosurgery, Royal University Hospital, University of Saskatchewan, Saskatoon, Sask.

Background: The routine histopathological examination of discectomy specimens remains common practice in many Canadian hospitals, although it rarely, if ever, detects clinically unsuspected disease. The objective of this study was to perform a cost–benefit analysis of this practice. To the best of our knowledge, this is the largest study of discectomy specimens ever reported. **Methods:** A database analysis identified all intervertebral disc specimens obtained during spinal procedures over an 8-year period (1996–2004). In each case, the preoperative indication for surgery was determined by review of the medical records. Benign and noninfectious indications were considered routine, and all others were considered nonroutine. A medical

chart review was used to determine if any abnormal pathology results had an impact on subsequent patient care. Cost–benefit values were calculated. **Results:** A total of 1848 discectomy specimens were identified. There were 1775 specimens obtained during 1719 routine procedures. Of these, 4 specimens in 4 cases had abnormal pathology, and 1 of these abnormal results affected the course of subsequent patient care. There were 73 specimens from 53 nonroutine cases. Of these, 61 specimens from 42 procedures had abnormal pathology, and 12 specimens from 10 procedures had normal pathology. In routine cases, the cost of making an unexpected abnormal pathological diagnosis was $42 156 per abnormal finding and $168 625 per clinically significant abnormal finding. In nonroutine cases, the cost was $114 per abnormal finding. **Conclusion:** Routine histopathological examination of disc specimens is not justified. The decision to send specimens for pathological examination should be based on clinical judgment.

Please note: This study was supported by the Saskatoon Health Region.

Incidence of adjacent segment degeneration in extended thoracolumbar fusions. *E. Abraham.* Dalhousie University, St. John's, Nfld.

Purpose: Adjacent segment degeneration (ASD) can occur after spinal fusion, disc degeneration, spinal stenosis, deformity, spondylolisthesis and fracture are observed. The incidence is unknown, and its occurrence difficult to predict. Further major surgery is required to correct the clinical problem that exists although not all cases of ASD are symptomatic. The primary purpose of this study was to identify the incidence of ASD after multilevel (3 level) thoracolumbar fusions for degenerative disorders. Risk factors for ASD were to be determined. **Methods:** Over 400 spinal fusions of 3 levels or greater, minimum 5-year follow-up were assessed for ASD. Radiographic data were available from a prospective data bank. The radiological incidence of ASD was distinguished from those that were clinically significant as determined by the Oswestry disability index, back and leg pain visual analog scales. **Results:** The incidence of ASD after extended spinal fusions overall was 20%. Clinically significant ASD requiring further surgery was 12%. The incidence varied according to location of the fusion, number of levels, age and pre-existing disc degeneration and/or deformity at the end vertebrae. Overall it was difficult to predict risk factors, but trends were noted. Long fusions (3 levels) have a significantly high risk of ASD by 5 years after the indexed operation. **Conclusions:** The incidence of ASD by 5 years post–spine fusion of 3 or more levels is 20% in over 400 cases. Twelve percent of these indexed cases needed further surgery. ASD is a clinically significant entity that deserves further study to aid in its prevention.

Fusion for degenerative lumbar spondylolisthesis: a systematic review. *R. Martin, H. Braunsfurth, E. Wai.* University of Ottawa, Ottawa, Ont.; University of Bochum, Bochum, Germany.

Background: There is a lack of consensus regarding the role of spinal fusion in treating degenerative spondylolisthesis. The objectives of this systematic review were to identify and analyze the scientific evidence comparing: (1) decompression with fusion to decompression alone; and (2) instrumented fusion to non-instrumented fusion. **Methods:** Relevant randomized controlled trials and comparative studies since 1966 were identified through a literature search using Medline, Embase and Cochrane library along with a hand search of relevant journals and proceedings of annual international spine meetings. Specific inclusion/exclusion criteria were determined ad hoc. Two independent reviewers abstracted all data. **Results:** Sixteen studies were identified. The overall methodological quality of most studies was low. Pooled analysis showed that decompression with fusion resulted in better outcomes than decompression alone (odds ratio [OR] 5.00; 95% confidence interval [CI] 2.5–10.02) and that instrumented fusion produced slightly better results than non-instrumented (OR 2.05; 95% CI 1.15–3.66). However, the results favouring instrumentation were significantly heterogeneous. Pooled analysis showed that instrumented fusion facilitates solid fusion better than non-instrumented fusion (OR 4.85; 95% CI 2.62–8.98). **Conclusion:** To date, the evidence supports that fusion with decompression may lead to better clinical outcomes compared with decompression alone, but a definitive statement cannot be made because of the methodologically weak studies included in this analysis. Given the heterogeneous results, no conclusion can be made about the clinical effectiveness of instrumented fusion, but greater fusion rates were seen with the use of instrumentation. Further high quality trials are needed to delineate the role of fusion in treating degenerative spondylolisthesis.

The reliability of commonly used questions to determine whether lumbar spine patients have leg- or back-dominant pain — phase II. *K. Howse, H. Dornan, A. Gruszczynski, L. Vexler, J. Pollock, E. Wai.* University of Ottawa; Ottawa Health Research Institute, Ottawa, Ont.

Background: The ability to differentiate patients presenting with leg-dominant or back-dominant pain is important to identify appropriate patients for decompressive lumbar surgery. Phase I of this study demonstrated that self-administered questionnaires are unreliable at determining this. **Purpose:** The primary objective was to assess the reliability of a structured interview format for determining where a patient's pain predominates. **Methods:** Seven different and commonly used questions for determining location of pain were pilot tested and considered to be simple and easy to understand by patients. These questions were administered using a structured interview and retested at 2 weeks. These results were also compared with the clinician's assessment (blinded to the results of the interview/questionnaire). **Results:** Thirty-one patients participated in the interviews. The kappa values for the separate items ranged from 0.26 to 0.65 in the structured interview format. Compared with clinician's impressions, the reliability ranged from 0.33 to 0.44. **Conclusion:** Only 2 items in the structured interview format demonstrated good test–retest reliability. None of the items demonstrated good reliability compared with the clinician's impression. These results suggest that the concept of back- or leg-dominant pain is complex and may not be easily as-

sessed. Further research and clarification of this concept may help to better identify patients appropriate for surgery.

Appropriateness of CT and MRI scans in low back pain. ***H. Dornan, P. Shim, L. Vexler, A. Gruszczynski, E. Wai.*** **University of Ottawa; Ottawa Health Research Institute, Ottawa, Ont.**

Background: Back pain accounts for a large proportion of referrals from family physicians for computed tomography (CT) and magnetic resonance imaging (MRI) scans. Due to the high costs and excessive wait times for such scans, it is imperative that they be ordered only for appropriate indications. **Purpose:** This study: i) examined the prevalence of inappropriately-ordered CT and MRI scans by primary care physicians in patients presenting at a tertiary spinal clinic for assessment of lumbar spinal disorders; and ii) established guidelines that can be given to general practitioners. **Methods:** The Delphi technique was used to generate a list of criteria for ordering CT/MRI scans for low back pain from a panel of experts comprised of orthopedic spinal surgeons, neurosurgeons and a neuroradiologist. A retrospective review was conducted of the history and physical examination components of 101 spinal consults to determine if conditions were satisfied for appropriate indication of a CT/MRI scan. **Results:** It was determined that 60% of the scans were requested for clearly inappropriate indications, 35% were requested for clearly appropriate indications and 5% were requested for relatively appropriate indications. The reliability of the list of criteria was tested using a second independent review of 30 random consults, yielding a weighted kappa statistic of 0.89, with 90% complete agreement between the 2 observers. **Conclusions:** These results reveal the need for evidence-based guidelines for imaging in the treatment of lower back pain, as well as a strategy for the widespread implementation of such guidelines in family practice.

Spinal cord monitoring during scoliosis surgery: a survey of Canadian practices. ***M. Camp, D. Borschneck.*** **School of Medicine; Division of Orthopaedic Surgery, Queen's University, Kingston, Ont.**

Background: Surgical treatment of scoliosis with a high degree of correction carries a risk of neurologic complications of about 0.5%. Damage to the spinal cord can be detected early by means of consistent intraoperative spinal cord monitoring. The purpose of this survey was to document current neurophysiologic monitoring in Canada. A questionnaire was sent to all pediatric scoliosis surgeons throughout Canada to determine which methods of intraoperative spinal cord monitoring are currently being used by Canadian surgeons during scoliosis surgery. The survey would help determine whether practice environment, size of community and yearly scoliosis case load have any influence on a surgeon's method of intraoperative monitoring. **Methods:** We used a cross-sectional survey design to examine surgeons' preferences in the intraoperative monitoring of the spinal cord during scoliosis surgery. The survey evaluated surgeon demographics, surgeons' past and current intraoperative monitoring techniques including; somatosensory evoked potentials (SEPs), motor evoked potentials (MEPs) and the Stagnara Wake-up Test. Additionally, the survey evaluated surgeons' current monitoring thresholds for intervention. We mailed this survey to pediatric scoliosis surgeons throughout Canada. **Results:** We are currently receiving responses and will continue to survey surgeons until February 2006. Parameters will include those outlined in the Methods section. At present we have received responses from 9 out of the 15 academic centres in Canada. **Conclusions:** To be determined. This study will have an ability to determine the current standards of intraoperative spinal cord monitoring during pediatric scoliosis surgery in Canada.

The reliability of a classification system for degenerative disc disease of the lumbar spine. ***E. Pedersen, K. Thomas, J. Bouchard.*** **Division of Orthopedic Surgery, Department of Surgery, Faculty of Medicine, University of Calgary, Calgary, Alta.**

There are many classifications for lumbar disc herniations and degenerative disc disease most of which use MRI, radiographs and clinical information to grade the pathology. Recently, Thalgott et al created a classification system that includes provocative discography to capture internal disc disruption as well as an assessment of the facet joints in order to identify pathology that may be amenable to treatment with an artificial disc replacement. The hypothesis of our study is that the classification system for degenerative disc disease of the lumbar spine as described by Thalgott et al has both inter- and intraobserver reliability.

Twenty cases of patients with multilevel provocative discography, MRI and radiographs of the lumbar spine at the Foothills Hospital were selected for this study. All identifying data were removed and 2 orthopedic spine surgeons rated each case according to the classification system on 2 separate occasions. The inter- and intrareliability of this classification system were calculated using weighted non-dichotomous kappa statistics.

This study is limited in the small sample size; however, it does provide useful information about the reliability of this classification system. In the future, a larger prospective study documenting the presentation, treatment and outcomes of these patients needs to be performed to see if this classification system guides treatment decisions and leads to improved patient outcomes.

Assessment of spinopelvic morphology in adolescent idiopathic scoliosis: comparison with normal adolescents. ***J.M. Mac-Thiong, H. Labelle, J.A. de Guise.*** **Research Centre, Hôpital Sainte-Justine; Department of Automated Production Engineering, École de Technologie Supérieure, Montréal, Que.**

Aim: Compare the spinopelvic morphology between normal adolescents and subjects with adolescent idiopathic scoliosis (AIS). **Methods:** The spinopelvic morphology was assessed from the anteroposterior and lateral standing radiographs of 27 normal adolescents and 29 subjects with AIS. All AIS subjects had a major Cobb angle of 30° or more. Spinopelvic morphology was characterized by 19 parameters in the sagittal plane

and 26 parameters in the coronal plane. Linear parameters were expressed as a percentage of the mean femoral head diameter. Comparisons were made using bilateral Student's *t* tests and a level of significance of 0.05. **Results:** There was no difference in spinopelvic morphology between the 2 groups in the sagittal plane. In the coronal plane, significant differences were found for right pelvic length, right iliac height, left and right pubic length, left obturator foramen width, bicristal distance, bituberal distance, biacetabular distance, pubic symphysis width, pelvic inlet and subpubic angle. There was no significant pelvic asymmetry in AIS subjects. **Conclusion:** This is the first study that specifically evaluates the sagittal and coronal pelvic morphology in AIS. The results suggest that the coronal pelvic morphology is distorted in AIS. A longitudinal study is required in order to evaluate the influence of the pelvic morphology in the progression of adolescent idiopathic scoliosis.

Surgical classification of lumbosacral spondylolisthesis in children and adolescents. ***J.M. Mac-Thiong, H. Labelle.*** **Research Centre, Hôpital Sainte-Justine; Department of Surgery, Université de Montréal, Montréal, Que.**

The proposed classification is the first specifically designed to guide surgical treatment of L5–S1 spondylolisthesis in children and adolescents, and to incorporate recent knowledge in the study of sagittal spinopelvic balance. The classification is based on the following: 1) the degree of slip, 2) the degree of dysplasia and 3) the sagittal spinopelvic balance. To classify a patient, the degree of slip is quantified first to determine if it is low-grade, high-grade or a spondyloptosis. Then, the degree of dysplasia is evaluated based on 7 criteria, in order to separate patients with low- and high-dysplastic spondylolisthesis. Finally, the sagittal spinopelvic balance is assessed from the measurement of the pelvic incidence (PI), sacral slope (SS) and pelvic tilt (PT). For low-grade spondylolisthesis, it is classified as low PI/low SS (nutcracker type) or high PI/high SS (shear type). For high-grade spondylolisthesis, it is classified as high SS/low PT (balanced pelvis) or low SS/high PT (vertical sacrum). Such a comprehensive classification could allow to better evaluate and compare available surgical techniques, and to optimize the treatment of L5–S1 spondylolisthesis. Because the classification was designed so that groups are organized in an ascending order of severity, it becomes easier and more intuitive to develop an associated surgical algorithm because the complexity of the surgery should increase as the severity of the spondylolisthesis increases. A tentative treatment algorithm is proposed but it is not definitive because further studies are still required to define the most appropriate treatment for each group.

Revision strategies for cervical arthroplasty: results of a multi-surgeon international survey. ***V. Joseph, L. Sekhon, N. Duggal, E. Shenouda, D. Choi, R. Bertagnoli, E. Massicotte, M.G. Fehlings.*** **Krembil Neuroscience Centre, Toronto Western Hospital, University of Toronto, Toronto, Ont.; SpineNevada, Reno, Nev.; University of Western Ontario, London Health Sciences Centre, London, Ont.; Department of Neurosurgery, Frenchay Hospital, Bristol, UK; The National Hospital for Neurology and Neurosurgery, Queen Square, London, UK; St. Elizabeth Klinikum, Spine Center, Straubing, Germany.**

Aims/objectives: To look at the incidence and types of complication with cervical arthroplasty (CA) in the hands of various surgeons around the world and how they were dealt with. **Methods:** A questionnaire enquiring about specific complications of CA and their revision strategies was sent to the participating surgeons. **Results:** Seven surgeons completed the questionnaire. The surgeons' years of experience of doing CA varied from 1 to 4 years. The case load of CA done per surgeon averaged 51.1 in a total of 358 patients. A total of 427 implants were used: Prodisc (n = 219), Bryan (n = 145), Prestige (n = 61) and PCM (n = 2). Migration was seen in 5, heterotopic ossification in 4, spontaneous fusion in 4, kyphosis in 31, adjacent segment disease in 3, persistent/new compression in 4, abnormal stress on facet joints in 1, and failure at primary surgery 1. Eleven patients had revision surgery: CA extrusion (n = 2), persistent/new compression (n = 4), posterior migration (n = 3), adjacent segment disease (n = 1), excessive stress on facet joints (n = 1). Revision surgeries done were replacement of CA (n = 1), removal of CA and fusion (n = 5), posterior re-decompression (n = 4) and insertion of new device at adjacent level (n = 1). **Conclusions:** Complications of CA was seen in 12.4% and revision surgery done in 2.6% of the devices used. Revision strategies involved were replacement of CA, removal of CA and fusion, posterior re-decompression, and insertion of new device at adjacent level. This experience emphasizes the importance of case selection and attention to detail with CA.

Radiation exposure to the patient and orthopedic surgeon during scoliosis surgery, using standard fluoroscopy, fluoroscopic image guidance, and computed tomography image guidance. ***A. Athiviraham, D.P. Borschneck.*** **Division of Orthopaedic Surgery, Department of Surgery, Queen's University, Kingston, Ont.**

Radiation exposure associated with fluoroscopy often prompts concerns for stochastic effects (*Spine* 2004;29:1555-60, *Aust N Z J Surg* 1998;68:635-6, *Spine* 2000;25:2637-45). Previous research has studied radiation exposure during pedicle screw insertion, primarily in the experimental setting (*J Orthop Trauma* 1997;11:392-8, *Spine* 1999;24:975-82, *Spine* 2003;28:402-13, *Spine* 2000;25:1538-41). Multilevel pedicle screw fixation for scoliosis that uses standard c-arm fluoroscopy is associated with significant radiation exposure to both the surgeon and patient. This is concerning given that patients treated are frequently young individuals, who are more sensitive to radiation and have many years of expected life remaining. Image guided systems (IGS) have been documented to improve pedicle screw placement accuracy but may increase radiation exposure (*Neurosurgery* 2000;47:872-8). To our knowledge, no studies have compared radiation exposure with standard fluoroscopy to IGS systems in the clinical setting of scoliosis surgery.

The purpose of this randomized, prospective study is to compare the amount of radiation exposure to the orthopedic surgeon and the patient using standard fluoroscopy, fluoroscopically based image guidance and CT-based image guidance in the clinical setting of scoliosis surgery. Using a power

calculator, we estimate that we will need 3 patients per group to obtain a power of 0.8 and a confidence level of 95% (UCLA Department of Statistics Power Calculator available: http://calculators.stat.ucla.edu/powercalc/). In order to increase the power, we will increase the sample size in each group to 5. We will measure the radiation exposure to body (protected, unprotected), head, neck (protected, unprotected) and dominant hand of the orthopedic surgeon and to the body, head, neck and gonads (all unprotected) of the patient using dosimeter badges or rings placed at these locations.

Since we anticipate using a much higher number of pedicle screws per case than published reports, our hypothesis is that the increase in fluoroscopic time will be more significant in the standard fluoroscopy group compared the IGS groups. We will also estimate the yearly exposure for orthopedic surgeons performing scoliosis surgery for each group and compare this to the annual allowable radiation exposure for medical personnel recommended by the National Council on Radiation Protection and Measurement (NCRP).

Mortality, neurologic outcome and axonal survival within spinal cord white matter after acute traumatic cervical spinal cord injury in a geriatric population. ***J.C. Furlan, M.G. Fehlings.* Krembil Neuroscience Centre, Spinal Program, Toronto Western Hospital, University Health Network; Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ont.**

Background: This study examines the potential differences on mortality, neurologic outcome and axonal preservation in spinal cord white matter after acute traumatic cervical spinal cord injury (SCI) between younger and elderly individuals (age 65 yr). **Methods:** A cohort retrospective study was performed including consecutive cases of acute traumatic cervical SCI admitted from 1998 to 2000. Gender and causes of injury were treated as potential confounders. Additionally, a histopathological study using postmortem spinal cord tissue from individuals with motor complete cervical SCI and controls without neurotrauma was performed. Using NF200 immunostaining, the number of axons within corticospinal tracts (CST), dorsal column (DC) and lateral funiculus (LF) were quantitated. **Results:** Cohort: There were 23 elderly (10 female, 13 male; age 65–89 yr, mean 75 yr) and 28 younger individuals (4 female, 24 male; age 18–64 yr, mean 40 yr). A higher frequency of SCI among males in the younger group was observed ($p = 0.031$). Both groups were not significantly different regarding severity of SCI and survival in the acute care unit. There were no significant differences between both groups regarding the neurologic improvement. Analyzing a subset of SCI individuals who were followed by a minimum of 6 months post-SCI (31/50), the neurologic improvement was unaffected by age/gender, whereas there was a trend for an association between neurologic improvement and cause of SCI ($p = 0.064$). **Histopathology:** Seven SCI individuals (2 female, 5 male; ages 31–82 yr, mean = 60 yr) and 5 controls (2 female, 3 male; ages 30–73 yr, mean = 51 yr) with similar gender and age distributions showed significant differences regarding the number of axons within CST ($p < 0.001$) and LF ($p = 0.004$), but not DC. In controls, the number of axons within CST, LF and DC were not significantly correlated with age/gender. There were no significant differences between both groups regarding the extent of degeneration or for the number of preserved axons within the DC, LF and CST post-SCI. **Discussion:** Mortality and neurologic outcome were not significantly related to age. Although neurologic improvement was unaffected by age/gender, etiology of SCI might be associated with neurologic post-SCI. The number of axons within spinal cord tracts was unaffected by age in controls and in the SCI group. Age does not appear to affect the extent of degeneration after SCI.

The "citation classics" on traumatic spinal cord injury compared with the consumers' perspectives: a literature review in the era of the Internet. ***J.C. Furlan, M.G. Fehlings.* Krembil Neuroscience Centre, Spinal Program, Toronto Western Hospital, University Health Network; Division of Neurosurgery, Department of Surgery, University of Toronto, Toronto, Ont.**

Introduction: This study examines the characteristics of the top 100 most frequently cited articles ("citation classics") on traumatic spinal cord injury (SCI) that were published between 1986 and 2003, and compares this selected professional literature with the consumers' perspective. **Methods:** The citation classics were identified using the Internet database of the Science Citation Index Expanded and the Web of Science with the terms "spinal cord injury" and "spinal cord injuries." Meeting abstracts, letters and editorials were excluded. No language restriction was applied. The consumers' perspectives defined as the areas of greatest interest for people with SCI reported in 2 previous large-scale surveys included motor function, bowel and bladder control, sexual function and pain. **Results:** The final list of citation classics on traumatic SCI included 82 original articles and 18 reviews, which were cited 146 times on average. North America and Europe (99%) led the list. The years of publication were distributed in a bell-shape curve with a peak between 1992 and 1994. Topics on basic science (63%) were more frequent than clinical studies. Most of those articles (63%) were explicitly focused on at least 1 of the topics of greatest interest to individuals with SCI. Motor function was the leading topic in the matching list between professional literature and consumers' perspectives. **Discussion:** This bibliometric analysis, for the first time, identifies remarkable features of the citation classics on traumatic SCI published between 1986 and 2003. Those suggest a need for bench-to-bed translational studies in SCI research with focus on the consumers' perspectives in order to improve the care and quality of life of SCI individuals.

Posterior column reconstruction using autologous strut grafts following thoracic spinal tumour resection: a new concept and preliminary clinical experience. ***S.J. Lewis, G.Y.F. Lee, Y.R. Rampersaud.* Spinal Program, Toronto Western Hospital, University of Toronto, Toronto, Ont.**

Background: En-bloc resection of primary malignant tumours with spinal column invasion provides potentially curative resections. These resections can leave large defects in both the anterior and posterior columns. While anterior column reconstruc-

tion is well described, generally the posterior column is not reconstructed. We feel that large posterior column defects prevent solid posterior arthrodesis, relying solely on the anterior column for fusion. We describe our results of 10 consecutive patients who underwent successful en-bloc tumour resections followed by bony reconstructions of the posterior column to enhance posterior fusion. **Methods:** Ten patients underwent surgical excision of thoracic spinal tumours between August 2003 and April 2005. Three patients underwent vascularized pedicled rib graft, 6 patients had non-vascularized rib grafts, and 1 patient had autologous posterior iliac crest. The grafts spanned 2 levels in 4 patients, 3 levels in 2 patients and 4 levels in 4 patients. Six of the patients had preoperative radiation to the tumour. All grafts were protected with posterior instrumentation. **Results:** The mean age of the patients was 42.4 years (range 16–75 yr). Four patients had benign lesions (osteoid osteomas = 3, fibrous dysplasia = 1). The remaining 6 patients had malignant tumours (primary invasive lung cancer = 3, chondrosarcoma = 2, osteosarcoma = 1). All patients presented with severe localized spinal pain without neurologic deficits. In this series, no neurologic complications were encountered. At a mean follow-up period of 10.1 months, all the patients remained clinically stable and had significantly improved pain from early after surgery. There were no graft extrusions. CT scans at minimum 6 months after surgery showed solid incorporation of the grafts in all rib grafts. The case with the iliac crest graft showed a unilateral pseudarthrosis that was revised and grafted with morcellized local graft. **Conclusions:** Posterior column reconstruction using autologous strut grafts is a safe and feasible technique which offers additional structural support and fusion points for bridging substantial posterior column defects following en-bloc tumour resections.

Postoperative spinal epidural hematoma: management and neurologic outcome. ***G. Swamy, B. Tay, J. Cavanilles Walker, S. Hu, S. Berven, C. Ames, P. Weinstein, D. Bradford.* Division of Spine Surgery, University of Calgary, Calgary, Alta.; Spine Surgery, University of California, San Francisco, Calif.**

Introduction: Spinal epidural hematoma is a rare cause of postoperative neurologic deterioration. Our purpose was to review the UCSF (University of California, San Francisco) experience with postoperative epidural hematoma to aid in identification of those patients or procedures at risk, and examine the clinical outcome. **Methods:** We performed a retrospective review, identifying patients developing epidural hematomas as a complication of spine surgery. Chart review, extracting the patient's preoperative history, intraoperative data, postoperative course and radiographic review was carried out. **Results:** Over the 12-year period from 1991 to 2003, over 4053 spine surgeries were performed by the Orthopaedic Spinal Disorders group at UCSF, of whom 9 (0.2%) were diagnosed with and treated for spinal epidural hematoma. An additional 5 cases were identified from the Neurosurgical Spine Service, thus accounting for a cohort of 14 patients. The clinical manifestations of epidural hematoma varied widely. Only 4 patients had a diagnosis and hematoma evacuation within 36 hours of the index procedure; 10 patients presented with delayed neurologic deterioration between 3 and 7 days after surgery. All patients had normal preoperative coagulation parameters, and no patients had a bleeding diathesis. Four patients (29%) developed intraoperative coagulopathy and suffered excessive blood loss (> 2 L); however, only 1 patient had a persistant coagulopathic status postoperatively. Suprisingly, 10 of the 14 patients (71%) developed epidural hematoma despite the use of closed suction drainage. Thirteen patients were treated with hematoma evacuation within 24 hours of the diagnosis of hematoma. Ten patients (79%) returned to their preoperative neurologic status, and 4 patients suffered varying degrees of persistent neurologic loss, although all were classified ASIA D. **Conclusions:** Spinal epidural hematoma is a rare complication and occurs in 0.1 to 0.2% of cases. Spinal epidural hematoma should be suspected in patients with progressive pain or neurologic deficit after spinal surgery, and the clinician should recognize that delayed presentation is common. The magnitude of the surgical intervention does not seemingly predict formation of hematoma. Early evacuation of the hematoma can result in resolution of the neurologic deficit.

Multilevel thoracic stenosis secondary to ossification of the ligamentum flavum in a caucasian female. ***R. Avery, A. Engelbrecht, F.B. Maroun, G. Murray, J. Barron, N. Haché.* Division of Neurosurgery; Division of Neuropathology; Department of Radiology, Memorial University of Newfoundland, St. John's, Nfld.**

Ligamentum flavum ossificans is a well described entity in southeast Asian and Japanese populations, but is very rare in white populations. In females, this disorder is even more unusual, and involves primarily the cervical spine. The authors describe a 53-year-old woman with a several-year history of progressive pain, numbness and weakness of the lower extremities who was found to have significant ossification of the ligamentum flavum throughout the entire thoracic spine. Surgical decompression and stabilization of the affected region resulted in significant improvement of symptoms and a good functional outcome. T_2-weighted MRI and CT sagittal reconstructions of the spine were instrumental in making the diagnosis and in operative planning.

Long-term follow-up of operative adolescent idiopathic scoliosis (AIS) patients. ***M.J. Moreau, J.K. Mahood, D.M. Hedden, N.R. Dang, D.L. Hill, E. Lou, V.J. Raso.* Capital Health, Glenrose Site; University of Alberta, Edmonton, Alta.**

Purpose: Operative AIS patients are understandably concerned with long-term spinal stability. The fused scoliotic spine was believed to be stable during adulthood, however, recent research suggests that postoperative spinal changes occur. **Methods:** Fourteen AIS patients were followed 5–12 years postoperatively (mean 7.2, standard deviation [SD] 2.5 yr). All surgeries used modern segmental instrumentation techniques. Spinal Deformity Study Group (SDSG) radiographic parameters were measured at preoperative, immediate postoperative, 2-year postoperative and latest postoperative visits. Patients were aged 14.3 ± 1.5 years at time of surgery and 21.4

± 3.3 years at latest follow-up. All preoperative curves were classified according to Lenke. The major preoperative curve ranged from 46° to 82° (61° ± 10°). Long-term spinal stability of the group and a per-patient analysis of spinal stability were conducted. Change was defined as an increase or decrease of more than 10 units in a particular parameter during follow-up. **Results:** Operative AIS patients experienced an increase in main thoracic angle, coronal angulation of disc below lowest instrumented vertebra (CAD-LIV), lowest instrumented vertebra (LIV) tilt and T12-S1 sagittal alignment during follow-up. For the study group, 61 of 165 measured parameters (37%) changed more than 10 units. All patients changed in some parameters, although each patient changed in a unique manner. **Conclusions:** The fused spine was not entirely stable during the postoperative follow-up. Traditional Cobb angle measurements do not fully describe changes due to surgery. Assessing the full suite of SDSG radiographic parameters provides further insight into effects of surgery.

A SMART ORTHOSIS FOR THE TREATMENT OF SCOLIOSIS. ***E. Lou, M.J. Moreau, J.K. Mahood, D.M. Hedden, D.L. Hill, C. Chan, V.J. Raso.* Capital Health, Glenrose Rehabilitation Hospital; University of Alberta, Edmonton, Alta.**

Purpose: To evaluate whether a smart orthosis can improve the effectiveness of brace treatment for scoliosis. **Methods:** One male and 4 female patients, age 12.6 ± 2.2 years, who had worn their orthoses for up to 3 months were recruited for this study. The major Cobb angle of the patients before orthosis was 31° ± 5°. The smart orthosis was installed and used by these participating subjects for 4 weeks. The first 2 weeks was called a passive session — the system only monitored the load; the following 2 weeks was called an active session — the feedback module was activated which can automatically adjust the interface pressure between the body and the brace. **Results:** The average pad pressure from the 5 subjects was 7.7 ± 2.6 kPa. The average time that the orthoses were used was 72 ± 15% (12.6 h/d) of the prescribed time (17.5 ± 3.8 h/d) over the study period. During the passive session, the time that the pressure level was below, in-range and above the target level were 30 ± 11%, 53 ± 9% and 16 ± 7%, respectively. During the active session, the time that the pressure level was below, in-range and above were 17 ± 13%, 68 ± 14% and 15 ± 11%, respectively. **Conclusions:** Although the tightness of an orthosis for the treatment of scoliosis varies greatly during daily activities, the smart orthosis was able to assist patients to increase the time that the tightness level maintains at the prescribed level.

THE GOOD AND THE BAD EXPERIENCES WITH MY FIRST 100 LUMBAR DISC PROSTHESES. ***J.F. Roy.* Québec City, Que.**

PSYCHIATRIC DISORDERS ASSOCIATED WITH SCOLIOSIS: A PILOT STUDY OF A VALIDATED SCREENING TOOL. ***C.W. Reilly, D. Davidson, S. Davidson, A. Perdios, S.J. Tredwell.* University of British Columbia; BC Children's Hospital, Vancouver, BC.**

Purpose: The management of scoliosis and its impact on mental health has not been well investigated in the literature. It is the purpose of this pilot study to prospectively investigate the prevalence of psychiatric disturbance among adolescents with scoliosis using a validated screening tool. **Methods:** Patients who attended the scoliosis clinic at a Canadian tertiary pediatric referral centre voluntarily completed the previously validated Achenbach mental health clinical screening questionnaires, consisting of the Youth Self-Report, completed by the adolescent, and the Child Behaviour Checklist, completed by the parent. The questionnaires were scored using computer software provided by the developers of the screening tool. Questionnaires were rejected from analysis if greater than 8 questions were not answered, in accordance with the scoring protocol from the developers. **Results:** A total of 39 patients volunteered to participate in the study, of whom 27 (69%) had at least 1 complete questionnaire and were able to be included. Of these 27 adolescents, there were 4 males and 23 females with an overall mean age of 14.3 years, ranging from 12 to 17 years of age. There were 7 (26%) who had at least 1 questionnaire with at least 1 domain which screened positive. Of these 7 adolescents, 5 (71%) screened positive in at least 2 different domains, ranging from 2 to 5 domains. The most commonly affected domains, with 2 adolescents in each, were withdrawn behaviour, somatic complaints, externalizing behaviour, social difficulties and anxious or depressed mood. **Conclusion:** Of the adolescents screened, 26% screened positive for at least 1 domain of mental health disturbance and 5 of 7 screened positive in greater than 1 domain. Mental health concerns appear to be prevalent among adolescents with scoliosis at a pediatric tertiary care centre. This screening tool provides a reliable and feasible means by which to assess the mental health of adolescents being treated for scoliosis, a group which is at high risk for mental health disorders. As mental health status can have a significant impact on overall morbidity, it is essential that both the true impact of mental health status on adolescents with scoliosis, as well as a means by which the treating orthopedic surgeon can screen for the presence of mental health disorders to be determined. This pilot data clearly shows a high prevalence of mental health concerns in this population, mandating further study in this area.

ANTERIOR CERVICAL DECOMPRESSION AND FUSION: PLATE VERSUS NO PLATE. WHAT DO PATIENTS PREFER? ***R.J. Mobbs.* Department of Neurosurgery, Institute of Neurological Sciences, The Prince of Wales Hospital, Sydney, Australia.**

Study design: Retrospective, multicentre review. **Objectives:** To establish if patients prefer anterior cervical decompression and fusion (ACDF) with or without plate fixation. **Background:** There has been much controversy over the addition of anterior plate fixation for single level ACDF for degenerative pathologies. Authors state patient preference toward anterior plating in addition to decompression and interposition graft based on factors such as reduced requirement for cervical orthosis and rapid return to work. **Methods:** Using procedural codes, a search of patients from 4 major teaching hospitals in Australia from the years 1996–2003 was performed. If the patient had a repeat ACDF procedure for a degenerative pathology, the hospital

files were reviewed and the patient contacted. **Results:** Five-hundred and sixty-two patients had an ACDF during the study period. Thirty-four patients were identified as having a repeat ACDF procedure. Seven patients had an ACDF initially without a plate and a later procedure with a plate fixation at a different level. Four patients were contactable. All 4 patients preferred the procedure that included anterior plate fixation. Three of 4 patients stated less neck pain initially with the plated procedure. All patients preferred not having to wear a cervical orthosis for 6 weeks following their operation. Two of 4 patients stated that they felt more confident in the outcome following the plated procedure. **Conclusions:** Anterior cervical decompression and fusion remains the gold standard procedure for spondylotic radiculopathy. The data provides evidence to support patient preference of anterior surgery with the addition of a plate.

Anterior cervical discectomy and fusion: analysis of surgical outcome with and without plating.

R.J. Mobbs, N.K. Chandran. **Department of Neurosurgery, Institute of Neurological Sciences, The Prince of Wales Hospital, Sydney, Australia.**

Study design: Retrospective review. **Objectives:** The objective of this study is to analyze the differences in clinical and radiological outcome of anterior cervical discectomy and fusion for cervical degenerative disease, with and without the addition of an anterior cervical locking plate. **Background:** Although disc arthoplasty is gaining popularity for the treatment of degenerative cervical spine pathologies, anterior cervical decompression and fusion remains an excellent procedure. A review of over 300 cases of anterior cervical decompression and fusion by a single surgeon was performed with and without anterior plate fixation. Analysis of results of the 2 cohorts was performed. **Methods:** Two groups of patients were operated on by the same surgeon. The only difference in technique between the 2 groups was the addition of an anterior cervical plate, with all other technical details matching, including the use of iliac crest autograft. The indications for surgery for both groups was identical. We made an attempt to study radiological fusion, clinical outcome and complications between the non-plated and plated groups. **Results:** Anterior discectomy and fusion with plating in our series had a significantly higher fusion rate. Ninety-eight percent fusion was noted in the plating group as compared with 93.5% in the non-plating group (Fisher's exact test, $p = 0.029$). Union was faster in the plated group with no significant increase in surgical complications. Although clinical outcomes were superior in the plated group for the radiculopathy cohort, excellent outcomes were not significantly higher as compared with the non-plated group. The non-plated group had a significantly higher rate of poor outcomes, with 10% of patients requiring revision surgery for non-union, kyphosis, graft extrusion and graft collapse with foraminal stenosis; 1.8% of the plated group required revision surgery. **Conclusion:** Our main finding is that the addition of an anterior plate reduces the number of poor clinical outcomes but does not increase the number of excellent outcomes.

The radiographic failure of single segment posterior cervical instrumentation in traumatic cervical flexion distraction injuries.

H. Elgafy, C. Fisher, B. Kwon, M. Dvorak. **Department of Orthopaedics, University of British Columbia; Vancouver Spine Program, Vancouver General Hospital, Vancouver, BC.**

Study design: A retrospective radiographic review of 57 patients with single-level unilateral or bilateral facet fracture-subluxation/dislocations was performed. Only patients treated with single segment posterior cervical instrumentation and fusion were included. **Objective:** The primary objective of this study was to identify radiographic features that predispose to mechanical failure when these injuries were treated with single segment posterior cervical instrumentation and fusion. **Methods:** The inclusion criteria were single-level unilateral and bilateral facet subluxation or dislocation, with or without fractures and treated with single segment posterior fusion. Over an 8-year period (1995–2003) 85 patients were retrospectively identified. Twenty-eight patients (32.9%) were excluded due to lack of adequate radiographic follow-up. Fifty-seven patients were included in this study. There were 38 males and 19 females. The age average was 37.7 years (range 16–82 yr). The preoperative plain radiographs, CT and MRI were assessed to identify the fracture type, degree of kyphosis, translation and associated fractures. The follow-up radiographs were assessed for evidence of radiographic failure that was defined as either translation of the vertebral body greater than 3.5 mm and/or change in angulation of greater than 11° or radiographic evidence of hardware failure such as implant breakage or dislodgment. **Results:** Two patients (3.5%) showed gross radiographic loss of alignment on postoperative radiographs. Both had bilateral facet subluxations without fracture. The first was a 20-year-old with a bilateral facet subluxation without fracture, treated with a lateral mass plate and iliac bone autograft. He subsequently developed progressive facet subluxation and kyphosis 3 months after the index procedure requiring anterior fusion and plating. The second patient was a 34-year-old who sustained a bilateral facet subluxation as a result of a motor vehicle accident. He had an associated end-plate fracture. An interspinous wire and iliac bone autograft were used. He subsequently developed progressive kyphosis 4 weeks after the index procedure as a result of a spinous process fracture. In these 2 patients, radiographic failure correlated with a pure ligamentous bilateral facet subluxation without fracture. There was no correlation between radiographic failure and level of injury, associated end plate fracture, degree of translation or sagittal alignment at the time of injury, or with the method of fixation. There was no difference in the radiographic result when lateral mass plates were compared with interspinous wire. **Conclusion:** This study confirmed a high union rate (96.5%) with single segment posterior cervical instrumentation and fusion. Radiographic failure correlated with bilateral facet subluxation without fracture. There was no statistically significant difference in the outcome result between the lateral mass plates and interspinous wires.

The Canadian Spine Society would like to acknowledge unrestricted grants in support of continuing education from:

Gold-level sponsors

DePuy Johnson & Johnson/Ethicon
Medtronic of Canada Ltd.
Stryker Canada LP
Synthes (Canada) Ltd.

Silver-level sponsors

Kyphon Inc.
Wright Medical Technology Canada Ltd.
Zimmer of Canada Ltd.

Exhibitors

Aesculap Spine
Disc Orthopaedic Technologies Inc.
Galen Medical Ltd.
Joint Solutions Alliance
Millenium Biologix