

JOINT SECTION ON DISORDERS OF THE
SPINE AND PERIPHERAL NERVES

SPINE SECTION NEWSLETTER



The American Association of Neurological Surgeons
and
Congress of Neurological Surgeons



Gary L. Rea, PhD, MD

August 1995

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EDITOR'S NOTE

There are several organizations in the United States which have diseases of the spine as their primary focus. Most are comprised of individuals from a single discipline or revolve around a certain segment of spine disease. An organization which neurosurgical spine surgeons may want to evaluate further is the North American Spine Society (NASS). It currently has members from the orthopedic and neurosurgical community, as well as from physical medicine and other non-surgical groups. Although there is certainly economic

competition between these disciplines, the goal of each is to improve their patient's health. Perhaps, this can be done better if each has a clearer understanding of the methodology, philosophy, and attitudes of others treating spine diseases. I suggest that the members of the Joint Section who are interested contact the North American Spine Society and consider attending their annual meeting in Washington, DC, this year. There will be papers and information delivered regarding a multitude of subjects regarding diseases of the spine.

Addendum

For those interested in information regarding the "Outcome Studies" mentioned in the last newsletter, the SF-36 (Short Form Health Survey) can be obtained from The Health Institute, 750 Washington Street, NEMC 354, Boston, Massachusetts 02111. Information regarding the North American Spine Society (NASS) evaluation forms can be obtained by writing to the North American Spine Society, 6300 North River Road, Rosemont, Illinois 60018.

Book Review

Biomechanics of Spine Stabilization Principles and Clinical Practice

By Edward C. Benzel, MD, FACS
McGraw-Hill, Inc.

Reviewed by N.W.M. Thomas, MD

There is a paucity of books that combine both practical biomechanics and clinical information. This is what Edward C. Benzel, MD, FACS, has set out to do.

The first few chapters cover the anatomy and kinematics of the spine in a well-organized manner. There is a summary of the types of spinal instability with particular reference to the two and three column theories and the points system. The particularly difficult concept of spinal instability is

succinctly covered with good guidelines as to how to apply the knowledge to clinical cases.

The majority of the book concentrates on spinal instrumentation and how fixation affects the pathological spine. The different types of instrumentation are covered methodically, with chapters on the properties of implants, the design of constructs, and how to derive the most biomechanically sound

constructs. The biomechanics are explained clearly with numerous drawings to enhance the understanding of the practical aspects of spinal instrumentation.

The book is well set out, easy to read, and clearly illustrated. The biomechanical principles of spinal instrumentation are explained well with great emphasis on clinical applicability. This is superb reading for aspiring and experienced spine surgeons.

Spine Bibliography

Fusion and Spondylolisthesis

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AWARDS AND GRANTS

The Joint Section on Disorders of the Spine and Peripheral Nerves has set aside a fund to provide grant money for one to two grants per year in the range of \$15,000 to \$30,000. The intent of these grants are to: (1) provide seed money to help initiate clinical projects related to the spine and peripheral nerves, (2) provide a means of peer review of clinical research projects to help improve the quality of the proposal and, therefore, enhance its competitiveness for the National Institutes of Health (NIH) or other funding, and (3) continue funding on a yearly basis to establish the "Joint Spine Section" as a known funding source for quality clinical research to answer questions in the treatment of disorders of the spine and peripheral nerves.

Grants under this program would be directed to individual neurosurgeons who are the principle investigators of planned clinical studies requiring national level funding in order to be completed. Planning funds would be intended to support preparation of the grant proposals, external consultations, (i.e., biostatistical consultation) to assist in the development of the proposal, planning meetings, and the collection of pilot data. Work that can be completed without such support (such as literature review and preliminary protocol design) should be completed prior to applying for such a grant. Evidence that this work has been completed will be a primary factor in assessing the quality of the planning grant. The actual work of the proposed study should not be supported by this grant.

All interested neurosurgeons who wish to apply for grants should submit a grant proposal by August 30, 1995. The format of the proposal should follow that of the NIH grant package. Specifically, applications should not exceed five (5) single-spaced pages. Within these pages should be included the specific aims, pertinent literature review and prior studies review, a brief summary of the proposed study, a plan for utilization of the funds, and a detailed budget and budget justification.

Please send proposals to: Richard G. Fessler, MD, PhD
Department of Neurological Surgery
Box 100267, JHMC
University of Florida
Gainesville, Florida 32610

Awards will be announced at the Joint Section on Disorders of the Spine and Peripheral Nerves annual meeting in February, 1996.

At the February meeting, the Joint Section on Disorders of the Spine and Peripheral Nerves of The American Association of Neurological Surgeons and the Congress of Neurological Surgeons announced Simcha J. Weller, MD, Harvard Medical School, as the 1995 Mayfield award winner, and John R. Hurlbert, MD, University of Toronto, as the 1995 Joint Section Spine Fellowship Recipient. Dr. Weller presented his work on "Expression of the neuronal growth-associated protein GAP-43 is upregulated following experimental spinal cord injury in the rat and is augmented by local administration by interleukin-6." Dr. Hurlbert will continue his spine and peripheral nerve-related research during his postgraduate fellowship year at Barrow Neurological Institute in Phoenix, Arizona.

ABSTRACTS

SELECTED ABSTRACT FROM THE MEETING OF THE NEUROSURGICAL SOCIETY OF AMERICA

Sea Island, Georgia – 1995

Jeffrey Cozzens, MD
David Shapiro, MD
Ivan Ciric, MD
Theodore Eller, MD
Jack Perimutter, MD
Craig Baumgartner, PA-C, MBA
Karen Bailey, RN (Evanston, IL)

Clinical care guidelines were developed at the Evanston Hospital in 1994 to create and monitor a program of outpatient lumbar disc surgery. Outcome and cost data for all lumbar disc surgery for the first half of 1994 were examined retrospectively. From these data, average length of stay (2.9 days) and average direct hospital costs (\$3633) were determined. These data were also used to identify areas where improvement in the quality of care and cost reduction might be achieved.

A multi-discipline committee including neurosurgery, orthopedic surgery, anesthesia, and nursing was formed which examined these data. Areas where improvements in quality of care were needed included pre-operative patient education, anesthetic technique, surgical technique, post-anesthesia care, and changes

in both patient and care-giver expectations. This committee then wrote a protocol or "Critical pathway" for outpatient lumbar disc surgery. Data were then collected on a prospective basis from July 1, 1993 to February 15, 1994 on all individuals who underwent one or two level lumbar disc surgery.

There were 47 individuals who underwent lumbar disc surgery in the study period. Out of this number 43, or 91%, were able to go home on the afternoon of surgery. One individual required admission because of nausea and vomiting, one patient was admitted by error but wanted to go home, and two patients required more extensive surgery than originally planned. No individuals required admission for post-operative pain control or for urinary retention. Most individuals (95%) who were outpatients were satisfied with not remaining in the hospital after surgery. Direct hospital costs were found to be significantly reduced from previous levels.

Outpatient lumbar disc surgery appears to be safe, effective, and well tolerated by patients. There may be some instances when admission is required, but use of a critical pathway tends to minimize this outcome.

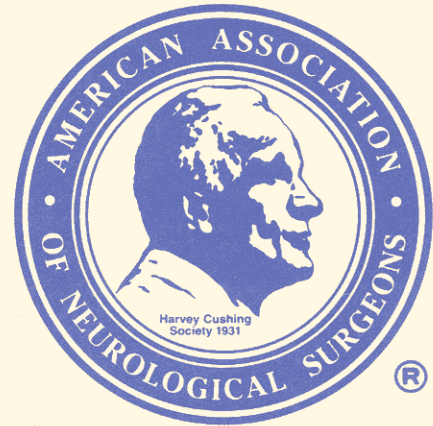


12th Annual Meeting of the Joint Section on Disorders of the Spine and Peripheral Nerves

The 12th Annual Meeting of the Joint Section on Disorders of the Spine and Peripheral Nerves, jointly sponsored by The American Association of Neurological Surgeons, will be held at Walt Disney World's Yacht Club in Lake Buena Vista, Florida, February 28 to March 2, 1996. This year's special themes include 1) the treatment of malignant neoplasms, 2) a symposium on bone, 3) controversies in spinal and peripheral nerve surgery, and 4) new frontiers in spinal surgery.

SELECTED ABSTRACTS FROM THE ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF NEUROLOGICAL SURGERY

Orlando, Florida – 1995



Histopathological Study of Autopsy Cases with Compressive Myelopathy Due to Epidural Malignancy, Cervical OPLL, and Cervical Spondylosis

Hideaki Iizuka, MD
Masaru Katoh, MD
Satoru Kadoya, MD (Ishikawa, Japan)

Patients with compressive myelopathy due to spondylosis or ossification of the posterior longitudinal ligament (OPLL) usually present a slowly progressing clinical course. Epidural malignant tumors, on the other hand, cause progressive myelopathy with relatively acute neurological deterioration. The pathophysiological mechanism in these conditions seems to be different. In the present study, 8 autopsy cases with malignant spinal epidural tumors (5), cervical OPLL (2), and cervical spondylosis (1) were examined to elucidate the differences of the pathological processes among these various clinical conditions. Among the epidural malignant tumor cases, two presented a complete transverse syndrome with no significant clinical improvement after surgical or radiation therapy. The remainder exhibited incomplete transverse myelopathy. The patients with OPLL presented severe myelopathy with muscle wasting of the arms and hands. One patient with cervical spondylosis, who did not have surgical intervention, was nonambulatory.

The main pathological changes of the epidural malignancy cases occurred in the white matter, as edematous malacia and multiple necrotic foci. In a case with more severe cord necrosis, several epidural and radicular veins were obliterated by malignant tumor cell nests associated with intramedullary vascular congestion. In the cases with cervical myelopathy due to OPLL and spondylosis, gray matter degeneration

with abundant glial reactions was apparent, particularly in the anterior horn. In the white matter, axonal degeneration in the lateral column was observed in one case with OPLL. In conclusion, epidural malignant tumors cause white matter-dominant lesions, which are attributed to venous congestions. On the other hand, in spondylotic myelopathy or OPLL patients, gray matter degeneration is predominant and the lesion might be caused by ischemia due to chronic continuous compression.

The Use of the Microsurgical Endoscopic Technique for Treating Affections of the Dorsal Spine: Indications and Early Results

D. Rosenthal, MD
R. Lorenz, MD (Frankfurt, Germany)

The microsurgical endoscopic technique (MET) was developed in 1992 to treat thoracic disc herniation. MET is a modification of the transthoracic technique which uses endoscopy as a way to reduce trauma on soft tissues. A further development of MET for microsurgical endoscopic tumor resection and stabilization was implemented in 1993, with endoscopic vertebrectomy and stabilization. A variety of affections of the dorsal spine (tumor, trauma, infection, and degenerative disease) was treated using this procedure. We report the early results obtained with the first 20 cases with MET.

The patients are intubated using a double-lumen tube and placed in a right or left decubitus position (according to the location of the lesion). Four trocars are inserted along the middle axillary line, unilateral

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ventilation allows surgery to be performed using the pneumothorax to uncover the ventrolateral aspect of the spine. A rigid endoscope with a 30° optic and a video camera are used. Instruments for microsurgical endoscopy and for ventral stabilization were specially designed for this purpose.

Between December, 1992, and July, 1994, 20 cases were treated using MET. Indications were: disc herniation in 8 cases, tumor in 6, trauma in 3, and

discitis in 3. In 7 cases, endoscopic stabilization was performed (4 tumor and 3 trauma cases). In 17 patients the neurological condition improved postoperatively; 2 with traumatic paraplegia did not recover postoperatively, and 1 (70 years old) died on the third postoperative day as a consequence of a fulminant heart infarction. Consumption of analgesics was reduced markedly. Patients with degenerative disease (disc herniation) left the hospital on the third day and tumor patients could start adjuvant therapy after the seventh postoperative day.

Although it is too early to draw definite conclusions, we can say that MET is a safe procedure that allows one to operate in the same fashion as using a transthoracic approach with marked reduction of trauma on soft tissues (thoracic wall). As a result of this, less consumption of analgesics, shortening or hospitalization time (mean 6 days), and early return to work are achieved.

Treatment of Traumatic Spondylolisthesis of the Axis with Nonrigid Immobilization: A Review of 62 Cases

Domogaj Coric, MD
John Wilson, MD (Winston-Salem, NC)

"Hangman's fracture" or "traumatic spondylolisthesis of the axis" are terms that have been used to describe a disparate group of fractures involving the posterior elements of C2. Current treatment regimens emphasize nonoperative therapy, generally rigid immobilization with halo orthosis and/or cervical tong traction.

Records of 62 patients with traumatic spondylolisthesis of the axis over a 19-year period (1975-1994) at one institution were reviewed. There were 37 male and 25 female patients with a mean age of 39.8 years (range 2 to 89 years). Admission flexion/extension plain films revealed that 47 patients (75.8%) had nondisplaced fractures or subluxation of C2 on C3 of < 6 mm and 15 patients (24.2%) had subluxation ≥ 6 mm. Two patients showed transient neurological deficit related to the hangman's fracture. Six patients (9.7%) were lost to follow up; the average follow up in the remaining 55 patients averaged 13 months. The average hospital stay was 10.5 days.

The majority of patients in this series (83.9%) were treated primarily with no rigid immobilization generally consisting of a Philadelphia hard collar for 8 to 14 weeks. Eight patients (12.9%) were treated with halo traction and two patients (3.2%) required operative fixation. Of the 48 patients managed primarily with no rigid immobilization, including 4 patients with combined Jefferson fracture and hangman's fracture, all patients showed stable fracture healing on flexion/extension follow up studies. No patient experienced neurological sequelae or significant disability at follow up examination. This series indicates that the majority of all hangman's fractures, including 94% of fractures with < 6 mm subluxation, may be successfully treated with nonrigid immobilization for 10 to 12 weeks. This management regimen avoids the increased morbidity associated with rigid immobilization in halo orthosis and the prolonged hospitalization necessitated by cervical traction as well as the increased costs associated with either of these modalities.

Preoperative Spinal Cord Area Predicts Surgical Outcome for Atlantoaxial Subluxation in Rheumatoid Arthritis: An Analysis of 134 Myelopathic Patients

Adrian T. H. Casey, FRCS
H. Alan Crockard, FRCS (London, England)

The aim of this study was to determine predictors of surgical outcome from cord compression secondary to rheumatoid atlantoaxial subluxation and evaluate the efficacy of surgery on the bed-bound, non-ambulatory patient.

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A prospective study was undertaken of 134 patients with rheumatoid arthritis (36 male, 98 female; mean age 62.9 ± 2.1 years) undergoing surgery between 1983 and 1993, to compare the clinical and radiological features between those patients with objective weakness and long-tract signs but still ambulant (Ranawat Class IIIA) and those who were bed-bound (Ranawat Class IIIB). The Class IIIB patients had a significantly higher postoperative morbidity rate (42% vs 24%) and mortality rate (13% vs 9%). Moreover, there was a

significantly poorer neurological and functional outcome for these individuals. Radiologically, the nonambulant patients were characterized by a greater degree of craniovertebral kyphosis ($p = 0.03$), a smaller canal diameter (14 ± 0.9 mm for Class IIIA vs. 12.7 ± 1.2 mm for Class IIIB), a higher incidence of vertical translocation ($p = 0.05$), and a smaller cross sectional area of the spinal cord ($p = 0.0001$). Longitudinal survival analysis reveals only 41% Class IIIB patients still alive at 5 years compared to 60% Class IIIA patients ($p = 0.002$). The spinal cord area (mean 66.7 ± 6.1 mm² for Class IIIA vs 49.3 ± 5.1 mm² for Class IIIB) was the only significant independent determinant of outcome in a multiple logistic regression model ($p = 0.0001$), although univariate analysis also revealed young age, male sex, the degree of vertical translocation, and cord diameter as significant variables associated with a successful outcome.

The onset of the myelopathic process is gradual, with neuropathological studies showing that cord damage in rheumatoid arthritis is secondary to stress and shear forces that result in permanent damage manifest by necrosis and cord atrophy. This suggests the presence of a cut off point beyond which surgery is unlikely to be successful, a fact corroborated by our data on cord area. Class IIIB patients have a significantly smaller cord area that Class IIIA patients with cord area being shown as the single major determinant of successful surgical outcome in this cohort of 134 myelopathic patients. This, taken in conjunction with a higher postoperative morbidity and mortality in "end-stage" disease, strongly argues for the preoperative cord area being considered in the overall treatment paradigm; earlier surgical intervention is advocated prior to irreversible spinal cord damage.

Rheumatoid Arthritis and the Craniocervical Region: Pathology, Natural History, and Surgical Implications Database Analysis of 332 Patients

Arnold Menezes, MD (Iowa City, IA)

Rheumatoid arthritis (RA) involved the cervical spine and craniocervical junction (CVJ) in 80% of cases. Discrepancy between radiographic abnormalities and the clinical picture has delayed attention until neurological catastrophe. Haphazard operative modalities abound with inconsistent results. Of 780 such patients evaluated, this prospective study (1977 to 1993) analyzes a database of 332 RA patients with symptomatic CVJ involvement operated on by the author.

Neurodiagnostic imaging encompassed radiographs, CT and CT/myelography, MRI, and effects of flexion/extension/traction with MRI. Reclining halo traction was maintained for 5 to 7 days (6 to 12 lb). Pathology encountered was: atlantoaxial instability (AAI) in 56 (anterior AAI in 44, posterior in 3, rotary AAI in 9); cranial settling in 267 (irreducible in 62, partially reducible in 43, reducible in 162); and primary granulation masses in 9.

On the 56 AAI's, 8 were irreducible, with tough granulation or complex rotary dislocation. Chronic instability > 8 mm developed large pannus and deficits. Cranial settling was irreducible in cases with > 15 mm odontoid, occipital condyles impacted into C2, posterior dislocation, or severe osteopenia. If untreated, progressive instability occurred. To patients with posterior occipital dislocations dies during initiation of traction. Large granulation masses indicated instability and active synovial disease.

Patients with predental space > 8 mm will develop neurological deficits. Cranial settling is progressive and fatal. 80% of cranial settling abnormalities can be reduced with halo traction, needing only occipito-cervical stabilization. Osteopenia and lateral atlantal mass erosion make screw fixation untenable. Odontoid fracture and posterior dislocation require immediate decompression and fusion without traction. Internal stabilization does not cause tough pannus and invagination to disappear.

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Biomechanical Alterations with Cervical Laminectomy and the Effects of Facet Fixation

Joseph F. Cusick, MD
John Reinartz, MS
Narayan Yoganandan, PhD
Frank A. Pintar, PhD (Milwaukee, WI)

Laminectomy is a common surgical method for decompression (or exposure) of the cervical canal, but the procedure may be complicated by instability. Limited information exists,

with the few laboratory studies indicating relative stability of the column after a 1 or 2 level laminectomy. The present study was designed to more closely represent the clinical situation by evaluating biomechanical effects of a multisegmented laminectomy to a combined loading vector within the physiological range. Eleven unembalmed human cadaver vertebral columns (C2-T1) were positioned in an electrohydraulic testing device with a custom designed fixture on the proximal end for loads applied in mid-sagittal line with eccentricity of 10 cm at a force controlled feedback to a maximum of 100 N (flexion bending movement of 10 Nm). Localized temporal kinematics were obtained from retroreflective targets in the vertebral components. After re-

sponses were recorded for the intact structure, a 3 level laminectomy (C4-6) were preservation of facets was performed. The specimen was reloaded with determination of histories from 6 axis load cell and force deflection curves, of which the most linear phase was the mean stiffness. The specimen thus had facet fixation by the criss cross technique (each facet joint secured) and loads reapplied.

Results showed that a mean stiffness of the intact column (7.58 ± 0.88 Nm) was significantly greater than that of laminectomy (6.41 ± 1.04 Nm). Maximum flextional rotations for the intact, laminectomized, and fixed specimen at the C5-6 level were $1.2^\circ \pm 0.3^\circ$, $4.6^\circ \pm 1.4^\circ$, and $0.8^\circ \pm 0.7^\circ$, respectively). ANOVA analysis determined the relative significance of motion data. Flextional rotations in the sagittal plane indicated no statistically significant differences between intact, laminectomized, and fixed specimens at the C3-4, C4-5, and C6-7 levels. In contrast, flextional rotations were higher for the laminectomized ($p < 0.05$) preparations at C5-6. Motion changes were most pronounced at the C5 level. These localized and global motion responses, as well as the strength characteristics (e.g., stiffness), contradict previous studies and indicate the added flexibility secondary to laminectomy which was greatest at the middle segment. Fixation offered partial restoration of spinal integrity.

ANNOUNCEMENTS

Mayfield Award Applications Solicited

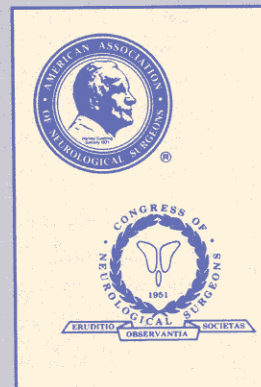
The Joint Section on Disorders of the Spine and Peripheral Nerves is inviting applications for the Mayfield Award(s) to be awarded at its annual meeting. Neurosurgical residents or fellows from the United States and Canada are invited to submit a detailed abstract describing relevant original clinical or basic science research. The Mayfield Award(s) consists of a \$500 honorarium, a plaque, and travel and lodging for the annual meeting of the Joint Section. One or two awards are given annually depending on the number and quality of submissions. Submit completed abstracts using the abstract form from the Joint Spine Section Annual Meeting to: Dennis G. Vollmer, MD, Chairman, Joint Spine Section Award Committee, Department of Neurological Surgery, Washington University School of Medicine, 660 South Euclid Avenue, St. Louis, MO, 63110. The deadline for receipt of abstracts is September 4, 1995.

Spine Fellowship Awards Available

The Joint Section on Disorders of the Spine and Peripheral Nerves is soliciting applications for the Joint Section Spine Fellowship Award. Neurosurgical residents interested in applying for this fellowship award should contact Dennis G. Vollmer, MD, Chairman, Joint Spine Section Award Committee, Department of Neurological Surgery, Washington University School of Medicine, 660 South Euclid Avenue, St. Louis, MO, 63110, to obtain application instructions. The award consists of monetary support for fellowship research, a plaque, and travel and lodging for the awardee to the annual meeting of the Joint Section. The deadline for receipt of applications for the Joint Section Spine Fellowship Award is September 4, 1995.

SELECTED ABSTRACTS FROM THE MEETING OF THE JOINT SECTION ON DISORDERS OF THE SPINE AND PERIPHERAL NERVES OF THE AANS/CNS

Phoenix, Arizona – 1995



A Comparison on Non-Operative and Operative Treatment of Thoraco-Lumbar Fractures

Philip Rafiy, MD
Glenn R. Rechtine, MD
Mark Hartman, MD,
Robert Alexander, MD
Lucy Love, MD
Ann Marie Chrin, ARNP (Tampa, FL.)

The purpose of the study was to review the non-operative versus operative treatment of acute thoracolumbar fractures in order to assess the neurological improvement and types of complications associated with each treatment form.

Between 1985 and 1992, 83 patients were retrospectively reviewed. Thirty-two patients in the non-operative group (group I) were aggressively treated on a rotores bed for 4-6 weeks. Twenty patients from the operative group underwent hook and rod instrumentation (group IIA) and posterior fusion. Thirty-one patients underwent a pedicle screw rod construct (group IIB) and posterior fusion.

The average age of groups I, IIA, and IIB was 37, 32, and 33 years, and the average follow up was 24, 25, and 26 months respectively. In group I, 5 out of 7 incomplete injuries improved one Frankel grade, and 63% returned to the same job. In group IIA, 5 of 6 incomplete injuries improved one Frankel grade, and 60% returned to the same job. In group IIB with 10 incompletes, 4 improved one grade and 2 improved two grades and 59% returned to the same job. The number of complications in groups I, IIA, and IIB was 2, 4, and 6 respectively.

This study demonstrated significant improvement of neurologic function in some incomplete injuries regardless of treatment; however, there was significantly less morbidity and mortality in the non-operative group.

Measurement of Exercise Tolerance on the Treadmill in Patients with Symptomatic Lumbar Spinal Stenosis: A Useful Indicator of Functional Status and Surgical Outcome

H. Gordon Deen, MD
Richard S. Zimmerman, MD
Mark K. Lyons, MD
Malcolm C. McPhee, MD
Joseph Verheijde, MA, PT, MT
Susan Lemens, PAC (Scottsdale, AZ)

A prospective study of patients with neurogenic claudication and lumbar spinal stenosis was undertaken to determine whether measurement of exercise tolerance on the treadmill would be useful in defining baseline functional status and response to surgical treatment. Twenty patients with an average of 73 years, all of whom had intractable neurogenic claudication and radiographically confirmed severe lumbar spinal stenosis, were studied. Lumbar decompressive laminectomy was performed in all patients. Pre-operatively and two months post-operatively, quantitative assessment of ambulation was carried out on the treadmill at 0 degree ramp incline at two different speeds: 1.2 miles per hour and the patient's preferred speed of walking. The following information was recorded: time to first symptoms, time to severe symptoms, and nature of symptoms

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(leg pain, back pain, or generalized fatigue). The examination was stopped after 15 minutes or at the onset of severe symptoms. The Wilcoxin signed rank test was used for statistical analysis.

In the pre-operative 1.2 mile per hour trial, the mean time to first symptoms was 2.68 minutes (median 1.31), and the mean time to severe symptoms was 5.47 minutes (median 3.42). In the post-operative trial at the same speed, 13 patients (65%) were able to walk symptom-free for 15 minutes. The mean time to first symptoms was 11.12 minutes (median 15), and mean time to severe symptoms was 11.81 minutes (median 15). The average improvement in time to first symptoms was 8.44 minutes (median 9.14). This was statistically significant ($p < .001$). Similar findings were recorded in the preferred walking speed trials. There were no complications from the treadmill testing procedure. These findings indicate that exercise stress testing on the treadmill is a safe, easily administered, quantifiable means of assessing baseline functional status and outcome following laminectomy in patients with symptomatic lumbar spinal stenosis.

Outcome After Lumbosacral Fusion: Worker's Compensation Patients vs. Noncompensation Patients

Chaim Rogozinski, MD

Abraham Rogozinski, MD (Jacksonville, FL)

Ninety-seven patients undergoing arthrodesis with instrumentation of the lumbosacral spine were studied retrospectively to evaluate patient outcome within one year of surgery. Pain scores and rate of return to work were compared between worker's compensation recipients (WC) and private insureds or nonworker's compensation patients (non-WC).

Methods

Posterolateral fusion was performed by the authors in all 97 cases, augmented by the same pedicle screw/rod instrumentation system. All were controlled for preoperative regimen, bone graft source, and postoperative rehabilitative protocol. Patient-supplied pain scores were recorded by an analogue scale with 0 representing no pain and 10 representing severe pain. Florida state worker's compensation guidelines were applied to identify: (1) return to work at full duty, (2) return to work with modifications, (3) not working, but medically cleared to return, and (4) not working, not medically cleared. These criteria were applied to both groups. Results were calculated from questionnaire review and interview.

Results

In the series, 78 out of 97 patients (80%) comprised the WC group and 19 (20%) comprised the non-WC group. By the end of the first year, 29 of 78 WC patients (37%) had returned to work; 29 (37%) were cleared to return but not working, and 16 (21%) were not working and not cleared to return. In comparison, patients in the non-WC group included 11 of 19 (58%) working by the end of the first year, 3 (16%) not working but medically cleared to work, and 3 (16%) not working and not medically cleared to work. Pain score comparisons showed that by the end of the first year 50 of 78 WC patients (64%) rated their pain improved pre-operatively; 12 (15%) remained the same, and 10 (13%) rated their pain worse. In the non-WC group, 11 of 19 (58%) rated their pain improved, 5 (26%) rated their pain the same and 0 rated their pain worse. Failure to receive clearance to return to work was associated with either continuing back morbidity or comorbidity.

Conclusion

Non-WC patients returned to work within the first year at a higher rate than WC patients. Since both groups had comparable pain relief ratings, return to work was adversely affected by socioeconomic factors in the WC cases.

UPCOMING
MEETING

10th Annual Meeting of the North American Spine Society

October 18-21, 1995

Washington Hilton and Towers
Washington, DC

Contact: North American Spine Society
6300 N. River Road
Suite 500
Rosemont, IL 60018-4231
Phone: 708-698-1630; Fax: 708-823-8668

The Biomechanics of the Degenerating Disc

N.W.M. Thomas, MD

From a very early age, there are maturational/degenerative changes in the disc and these result in altered disc biomechanics.

In the intact, well-hydrated disc the nuclear proteoglycans generates an osmotic pressure which absorbs water to create a gel matrix. The type I collagen content of the annulus imparts significant resistance to tensile forces. Loading results in a radial force being generated within the disc which is resisted by the circumferential stress generated in the inner annular fibers (therefore decreasing the natural tendency of the nucleus to bulge). There is dissipation of the load across both the nucleus and the annulus.

Maturation results in changes in the cell populations, and cell necrosis. Loss of nuclear proteoglycans with maturity results in a decreased osmotic pressure, decreased water content and less ability to resist compressive forces. Repetitive loading results in fatigue changes with radial and circumferential tears, fissure formation and a fragmented and necrotic nucleus. The loss of nuclear hydration and annular integrity results in there being a decrease in the disc height and the intradiscal pressure. There is therefore less stress generated in the annular fibers and there is greater nuclear bulging. There is reduced ability to

resist compressive forces and also less efficient distribution of the loading across the disc. The increased tendency of the nucleus to bulge predisposes to the possibility of disc herniation down a radial tear.

The well hydrated disc exhibits visco-elastic properties (creep, relaxation, hysteresis and fatigue). With degeneration the disc demonstrates less visco-elasticity. In a non-degenerated disc there is an exponentially decreasing change in deformation with time when a load is applied. This is as a result of the expression of water and the rearrangement of particles within the disc (creep). With degeneration there is increased stiffness of the disc as a result of the reduced water content. Relaxation (the diminution in the internal stresses when a constant load is applied) occurs in a non-degenerated disc as a result of creep. This is consequently reduced in a degenerated disc. The amount of energy that is converted to heat during cyclical disc deformation (hysteresis) is increased in the degenerated disc because there is less ability to dissipate the energy of loading in an efficient manner. The reduced visco-elasticity results in the disc being less able to attenuate the impact of loading and less able to distribute the load uniformly. The deleterious biomechanics of the degenerated disc perpetuates the degenerative process.

AANS PROFESSIONAL DEVELOPMENT COURSES

The AANS Professional Development Committee is presenting three hands-on courses to facilitate continuing education for neurosurgeons:

'95 Advanced Thoracic and Lumbar Spine Management Hands-On

Chicago, IL • September 15-17, 1995

Chairman: Charles B. Stillerman, MD

Associate Chairman: Edward Benzol, MD

"A superb update on current management approaches taught by the giants of spinal surgery." —1995 Course Participant

Stereotactic Neurosurgery Hands-On

New Orleans, LA • November 17-18, 1995

Chairman: Philip L. Gildenberg, MD

"I learned when to use stereotactic techniques and how to integrate stereotaxy into my practice." —1994 Course Participant

Minimally Invasive Neurosurgery: Neuroendoscopy Hands-On

Cleveland, OH • November 10-11, 1995

Chairman: Alan R. Cohen, MD

"This course increased my comfort with the anatomy and hand eye interface." —1994 Course Participant

For more information, or to register, call Kim Scharoff of the AANS Professional Development Program at (708) 692-9500 x38

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