JOINT SECTION ON DISORDERS OF THE
SPINE AND PERIPHERAL NERVES

SPINE SECTION NEWSLETTER

American Association of Neurological Surgeons
Congress of Neurological Surgeons

Nancy E. Epstein, MD, Editor — January 1990

MEETING ABSTRACTS

The combined Spine Section Newsletter has recently introduced a section devoted to highlighting abstracts from current neurosurgical or orthopaedic meetings which may prove of interest to Spine Section members. In accordance with this new tradition, selected abstracts from the Cervical Spine Research Society (New Orleans, December 5 - 8, 1989) and the North American Spine Society (Quebec, June 29 - July 2) meetings are presented.

ANNOUNCEMENT

The combined Spine Section of the AANS and CNS will hold their 6th Annual Meeting in Captiva Island, Florida from February 7 - 11, 1990. We look forward to seeing you there.

SELECTED ABSTRACTS FROM THE CERVICAL SPINE RESEARCH SOCIETY MEETING

#1 Anterior Cervical Discectomy and Fusion

Clements, DH; O'Leary, PF

The outcomes for 94 consecutive patients undergoing anterior cervical diskectomy and fusion were analyzed. All patients were evaluated with myelography and Myelo-CT studies which documented the predominant site of disease 100% of the time, while also revealing one or two additional spondylotic levels in 26% of cases. Seventy percent of patients were fused at one level, 29% at two, and 1% at three levels. Using Odom's criteria, postoperative good or excellent results were achieved in 88% of patients with single level disease, whereas success dropped to 60% with multilevel disease.

#2 CSF Leak During Anterior Disc Surgery

O'Donnell, H; Ducker, TB

The appearance of CSF leakage during anterior cervical surgery may indicate an intradural disc herniation rather than a technical error. The authors presented a case of a 54 year old male with just such a transdural cervical disc herniation, the incidence of which is estimated at 0.27% of cervical discs. Seven cases have been reported in the literature. Intradural disc herniations may be documented with combinations of MRI and enhanced CT scans, and should be considered in patients with unique upper extremity monopareses accompanied by myelopathy.

Intradural evaluation of these lesions from either the anterior or posterior routes should be considered based upon the location of the fragment.

#3 The Surgical Management of Cervical Soft Disc Herniation: A Comparison Between the Anterior and Posterior Approach
Herkowitz, HN; Kurz, LT; Overholt, DP

This study compared the efficacy of anterior versus posterior surgery for the resection of soft cervical discs. Twenty-eight patients were approached with anterior diskectomy and fusion utilizing the Smith-Robinson technique, while 16 had posterior laminectomy-foraminotomy with or without excision of the disc fragment itself. Discs were classified into two types. Type I lesions were anterolateral soft discs, while TYPE II lesions were soft central disc herniations. Thirty-three patients had Type I lesions and 11 Type II disease. Of the 17 Type I lesions approached anteriorly, 94% had excellent to good results while only 75% of the 16 aproached posteriorly experienced good to excellent outcomes. Alternatively, only anterior procedures were employed to address Type II central disc herniations. The authors concluded that: 1. anterior diskectomy and fusion provided better and longer term improvement for the treatment of lateral discs while, 2. anterior procedures provided safer and more effective treatment for the management of central lesions.

Although there is little to dispute regarding the second point, one must reconsider the assumptions as well as the operative procedures employed when addressing the Type I lesions. During the discussion period, it became clear that when the posterior approach was employed, the soft lateral discs were excised only part of the time, the exact figures being unavailable. In the absence of comparable degrees of anterior vs. posterior disc excision, the validity of such a comparison was questioned.

Paper 4: Compressive Strength of Auto- and Allografts for Cervical Fusions and the Effect of Sterilization
Wittenberg, RH; Coffee, MS; Moeller, J; White, AA; Hayes, WC

This study sought to establish biomechanical guidelines for the selection of graft material during anterior and posterior spinal fusions. The following conclusions were made:

1. Tricortical grafts in anterior cervical spine surgery are preferable to bicortical grafts as the former provided an immediate higher degree of compressive strength
2. The compressive strength of bank bone grafts harvested from younger cadavers provided better graft material
3. Sterilization with ethylene oxide did not markedly alter the quality of the grafts.
4. Hydroxyapatite proved to be more brittle than bank bone. Nevertheless, it was considered to be of clinical use as its compressive strength was adequate
5. Bank bone was preferred for older individuals

Paper 5: Anterior Cervical Fusion Using a Reversed Robinson-Smith Graft
Geibel, PT; Whitecloud, TS; Olive PM; Ledet, B

Eighty-one reversed Smith-Robinson anterior fusions were evaluated in 55 patients. Advantages of reversing the graft included maximal posterior distraction and decompression of the lateral uncovertebral joints while simultaneously providing the desired degree of disc space height restitution. Reversal of the Smith-Robinson graft, previously described by Bloom and Raney, afforded no increase in technical difficulty while providing a stronger and more physiologic biomechanical construct.

Paper 6: The Use of Freeze-Dried Allograft Bone for Anterior Cervical Fusions
Zdeblick, TA; Ducker, TB

The relative efficacy of tricortical autogenous iliac grafts and freeze-dried allografts for anterior fusion using the standard Smith - Robinson technique was compared in 87 patients over a two year period. A

In order to assess whether significant stenosis of the cervical spinal canal accompanies the Klippel-Feil (KF) Syndrome, 81 patients with this syndrome were retrospectively studied. The sagittal diameters obtained from lateral spine radiographs were assessed 567 times between the C1-C7 levels. Patients with the KF syndrome ranged from 3 - 14 years of age, and were compared with 36 age matched controls.

The authors discovered that significant cervical stenosis was present in KF patients at the unfused levels at C1, C3 and C4 when compared with the control population. They also determined that further studies should be aimed at establishing the relationship between stenosis and the different fusion patterns.

PAPER 26: Occiput to C-1 Translation in Downs Syndrome
Gabriel, K; Mason, DE

Eighty-five flexion and extension lateral cervical spine films obtained in 59 patients with Downs syndrome, were retrospectively evaluated to determine if a specific pattern of instability existed. Those with congenital cervical spine anomalies and C1-C2 instability requiring surgical intervention were excluded from this group. Occiput-C1 translation was measured utilizing the Weisel and Thorman Technique. Evaluation of the patients with Downs Syndrome demonstrated a range of 0 - 10 mm, with a mean of 2.57, whereas the normal upper limit should be 1 mm or less. Despite the increased incidence of radiographic abnormalities, the review of medical records did not demonstrate any neurological correlate of impaired function. These data, however, would suggest that the incidence of Occiput-C1 instability in patients with Downs syndrome was more prominent than previously anticipated.

PAPER 30: Evaluation of Current Extrication Orthoses in Immobilization of the Unstable Cervical Spine
McGuire, RA; Amundson, GM

The efficacy of multi-level cervical orthoses following spinal trauma were compared following flexion injuries in fresh cadaver specimens. The simulation was completed by transecting all soft tissue structures, except the anterior longitudinal ligament at the C4-C5 level. Lateral plain X-rays were then obtained before and after collar placement and following the application of 5 pounds of traction. There appeared to be no statistically significant difference in the efficacy of the Necloc, the Philadelphia, or the Stifneck collar systems in the immobilization of the cervical spine against flexion deformity. However, the Philadelphia Collar Halo system provided superior prevention of translational motion, sagittal rotation, and cervical deformation.

NORTH AMERICAN SPINE SOCIETY FOURTH ANNUAL MEETING

PAPER 2: Transitional Lumbosacral Vertebra: Incidence of Unilateral Sacralization of the Transitional Vertebra and its Significance in Associated Stenosis and Disc Herniation
Heithoff, KB; Bradford, DS; Schellhas, KP; Fritts, HM

Three hundred symptomatic patients with transitional vertebra were evaluated with lumbar CT and MR to assess the incidence of asymmetrical unilateral sacralization of transitional vertebrae. The incidence and location of stenosis and disc herniations were also assessed.

Unilateral sacralization of L5 or lumbarization of S1 was associated with increased osteophytic spurring of the facets on the lumbarized side with an increased incidence of lateral spinal stenosis at the level of transition (i.e. within the foramen on the lumbarized side between the transitional vertebra and the sacrum). No disc herniations were noted at the transitional level in any of the 300 individuals evaluated. However, 125 or 42% demonstrated disc herniation at the immediate cephalad interspace, herniations occurring 65% more commonly above the sacralized side.

PAPER 6: Prospective Evaluation of Surgical Treatment for Burst Fractures
Esses, SI; Toobsford, DJ; Kostuik, JP

The treatment of thoracolumbar burst fractures with posterior distraction techniques, including pedicle instrumentation (AO fixateur interne), and anterior decompression systems (Kostuik-Harrington device) was conducted in a random prospective fashion. Forty patients were evaluated with a minimum follow up of one year. Two individuals required both anterior and posterior surgery.

Prior to surgery 39 out of 40 patients demonstrated significant impingement within the canal itself. Forty-five percent of the canal was compromised in those undergoing posterior surgery, compared with 53% having anterior procedures. Following surgical intervention, these figures were reduced to 23% for those undergoing posterior intervention compared with 9% approached anteriorly. Despite the marked superiority of anterior techniques in the achievement of canal decompression, the incidence of postoperative kyphosis remained comparable for both groups.

Posterior distraction with instrumentation achieved effective decompression of the spinal canal and adequately corrected kyphosis in patients with more minor neurological deficits and less canal compromise resulting from burst fractures. Alternatively, anterior procedures restored more complete and reliable decompression in the presence of major neurological injury and significant cord compromise.

PAPER 7: Histopathologic Correlation of MRI Signal Patterns in a Spinal Cord Injury Model
Weirich, S; Cotler, H; Narayana, P; Harris, J

The MRI characteristics associated with spinal cord trauma were assessed in a rat model utilizing a standardized weight dropping technique. The MRI studies correlated hemorrhagic or edematous changes within the spinal cord with the degree of trauma induced in an effort to establish specific patterns of injury which could predict future outcome.

Intramedullary hemorrhage, edema, and necrosis which spread to adjacent segments following the initial injury, were found to correlate with central areas of central hypointensity on MRI scans. Acutely, central hypointensity reflected the initial presence of deoxyhemoglobin and later methemoglobin, both of which correlated hemorrhagic changes in the gray matter. Later hypointense changes correlated with increased cellular infiltration and necrosis which reflected the conversion of the blood products to hemosiderin. Edema of the white matter and myelin degeneration was then later found to correlate with areas of peripheral hyperintensity.

PAPER 8: Surgical Treatment of Spine Fractures and Fracture Dislocations Using Pedicle Screw and Plate Fixation
Akbarnia, BA; Gaines, R; Keppler, L; Lorenz, M; Merenda, JT; Zindrick, M; Niemann, P.

This multicenter trial, designed to assess the efficacy of transpedicular screw and plate fixation in the stabilization of unstable spine injuries, included 95 patients: 68 burst fractures, 21 fracture dislocations, 4 seatbelt injuries, and 2 with compression fractures. Seven patients had complete neurological injuries, 42 were incomplete, while 46 remained neurologically normal. All fractures except 4 were between T12-L5. Sixty-five patients had three levels fused.

Following surgery, 87 maintained their alignment. Of 520 screws placed, 17 broke in 12 patients, while 3 pulled out in 2 individuals. Despite instrumentation complications in 17 patients, 10 went on to achieve solid fusion. Whereas all patients with complete injuries remained complete, 39 with incomplete lesions improved and 3 were unchanged.

Pedicle screw and plate fixation provided excellent fixation, while allowing for the inclusion of fewer levels in the fusion construct. The use of instrumentation facilitated the preservation of the normal sagittal contour of the spine while allowing for posterolateral spinal decompression.

higher incidence of delayed union was observed for those patients receiving freeze-dried allografts.

PAPER 7: Anterior Cervical Plate Fixation with the Titanium Hollow Screw Plate System (THSP) - A Preliminary Report
Suh, PB; Kostuik, JP; Esses, SI

Morscher developed the Titanium hollow screw plate system (THSP) for anterior cervical fusions which no longer required screw perforation of the posterior cervical cortex, thereby reducing the risk of cord injury. This system consisted of a titanium plate with 4.5 mm screw holes. The screws themselves come in two parts; an outer 4.5 mm hollow screw with multiple perforations, plus an inner 16 mm expansion screw. The system was employed in 13 surgical procedures, 8 following trauma, and 5 for degenerative disease.

Ease of application and the reduced risk of cord injury enhanced the THSP system's adaptability to both traumatic and atraumatic multilevel anterior disease.

PAPER II: Gunshot Injuries to the Cervical Spine
Kupcha, P; An, H; Cotler, JM

Thirty low velocity gun shot injuries to the cervical spine, including lesions to the esophagus, carotid, and vertebral arteries, were evaluated in order to determine whether surgical intervention altered patients' long term prognoses. No surgical procedure was conducted in 15 patients. For the remaining 15 where surgical explorations were performed, only 4 were positive. These four all had large metal fragments in the spinal canal, while another 6 with similar sized intracanalicular lesions were not explored. Surgery failed to enhance recovery while subjecting patients to additional acute and chronic postoperative complications including CSF leakage, wound infection, meningitis, pseudomeningocele, deep venous thrombosis, decubitus ulcers, gastrointestinal bleeding, pulmonary, and urological problems.

The authors concluded:

1. Routine surgical exploration of gun shot wounds to the cervical spine were not warranted as most of these injuries were "stable".
2. Removal of the metallic fragments and decompression of the canal in most instances were not indicated following acute gun shot wounds and did not correlate with improved neurological outcome.
3. The medical complications which followed wound exploration were significant.

Paper

RESIDENT AWARD PRESENTATION

Anatomical Comparison of the Roy-Camille and Magerl Techniques for Screw Fixation of the Lower Cervical Spine
Heller, JG; Carlson, GD; Abitbol, JJ; Garfin, SR

The Roy-Camille and Magerl techniques of posterior lower cervical screw fixation were compared in 10 fresh human cadaveric specimens between the C1-T4 levels. The Magerl method was used on one side, and the Roy Camille method on the other. A three zone anatomical grading system was then applied by independent observers to assess the final location of the screws employed by the respective techniques. Soft tissues were additionally examined to assess whether these structures were at risk for injury secondary to the trajectory of the screws. Ninety-six percent of the Roy-Camille screws were properly located whereas 42% of those placed with the Magerl technique were improperly located, although this difference appeared to decrease with greater operative experience.

Alternatively, the Roy-Camille technique, although less likely to place the nerve roots at risk, was associated with a higher incidence of facet injury at the distal extremes of a fusion.

PAPER 15: The Incidence of Abnormal Cervical Spine MRI Scans in Asymptomatic Individuals: A Prospective and Blinded Investigation
Boden SC; McGowin, PR; Davis, DO; Dina, TS; Mark, AS; Wiesel, SW

The incidence of significant abnormalities found on cervical MRI scans of asymptomatic individuals was prospectively studied. Three independent neuroradiologists randomly evaluated 100 MRI scans, 63 of which were obtained from normal individuals, and 37 from symptomatic patients. Nineteen percent of the asymptomatic patients exhibited significant MRI findings, although the incidence of abnormalities significantly increased with age. Under the age of 40, 14% of studies were abnormal and included a 10% incidence of herniated discs, and a 4% frequency of foraminal stenosis. Alternatively, for patients over 40, significant MRI findings were observed 28% of the time, and included a 5% incidence of disc herniation, a 3% frequency of disc bulges, and a 20% probability of attendant foraminal stenosis. The probability of encountering more than one pathological level increased from 25% in patients under 40 to almost 60% for those over 40. Because of the high incidence of asymptomatic MRI findings, the authors emphasized the continued necessity for close clinical correlation.

PAPER 18: Gentamicin Penetration into Normal Rabbit Nucleus Pulposus
Currier, BL; Banovac, K; Eismont, FJ

This laboratory based study, conducted in a rabbit model, documented the efficacy of intravenous gentamicin therapy as antibiotic prophylaxis in spine and disc surgery. Two hours following intravenous injection, peak concentrations of gentamicin were achieved in the rat nucleus pulposus. If one were to assume a similar rate of penetration into the human disc, a single bolus of intravenous gentamicin administered 2 hours prior to surgery should provide optimal antibiotic prophylaxis.

PAPER 20: Motor Evoked Potentials: Evaluation of Central Motor Pathways in Patients with Cervical Spine Disorders
Dvorak, J; Theiler, R; Herdmann, J; Grob, D

Motor evoked potentials (MEP) appear to provide a sensitive method of determining the involvement of motor pathways in cervical spine disease. However, only the recent introduction of Magnetic motor evoked potentials has made MEP's clinically useful by eliminating the attendant risks and complications previoulsy associated with electrical transcranial stimulation techniques.

In Dvorak's study, recordings obtained from the biceps brachii, abductor pollicis brevis, and abductor digiti minimi muscles, were calculated as the difference between the latency after transcranial magnetic stimulation of the motor cortex and the latency after magnetic stimulation of the motor roots over the cervical spine. Cervical spine disease in the population studied consisted of rheumatoid arthritis in 51 patients, degenerative disease in 56, and soft tissue trauma in 29. Significant delay of the MEP's was obtained in 57% of patients with rheumatoid arthritis, 75% of those with degenerative disorders, and 69% of those with soft tissue trauma. MEP's were delayed in 86% of those with neurological deficit, as well as in 57% of those with brachialgias without deficit.

In Conclusion:

1. Seventy-six percent of 136 individuals with cervical spine disease with or without neurological deficits or radiological abnormalities demonstrated abnormal MEPs
2. MEP's appear to provide a sensitive method for the detection of pathological involvement of the motor pathways
3. Magnetic elicitation of MEP's is a painless procedure for studying the motor tracts and is recommended as a screening method to be used even prior to neurological studies
4. Localization with MEPs may be accurate
5. MEP's may indicate the degree of motor involvement
6. In soft tissue trauma MEP's may provide an anatomical correlate of injury

PAPER 25: Spinal Stenosis and the Klippel-Feil Syndrome
Pizzutillo, PD; Mandell, GA; Sachoedler, S

PAPER 9: Traumatic Herniated Discs in Unstable Spinal Injuries: Incidence and Detection
Pratt, ES; Sapengler, DM; Green, DA

The MRI scan has proven valuable in the delineation of acute herniated discs associated with cervical, thoracic, or thoracolumbar spinal injuries. Of 91 patients studied, 35 had cervical, 11 thoracic, and 45 thoracolumbar trauma. All patients were also assessed with plain X-rays and non-contrast CT scans. Following cervical trauma, discs were observed on 45% of MRI evaluations, studies demonstrated herniated discs in 50% of cases while in the thoracolumbar spine, the MRI showed a 13% incidence of herniated discs.

Herniated discs were not missed where preoperative MRI scans had been obtained, and some stressed its superiority in the evaluation of the anterior subarachnoid space. Acutely, the MRI helped distinguish between edema, hematoma, and disc herniation, while also affording a basis of comparison for the delayed evolution of myelomalacia or syrinx formation.

Certainly, the unusually high incidence of acute disc herniations defined using the MRI scan in patients who had sustained acute spinal injuries warrants its more rountine inclusion in patient assessment.

PAPER 10: A Multicenter Analysis of Automated Percutaneous Diskectomy
Kahanovitz, N; Viola, K; Watkins, R; Dawson, E; Goldstein, T

A prospective multicenter evaluation of 38 patients with disc disease treated with automated percutaneous diskectomy (APT) was conducted. All APT patients had single level unilateral L4-L5 or L5-S1 discs documented on CT scans, myelograms, or MRI scans. Patients followed an average of 16.8 months, rated their degree of pre and postoperative pain, numbness, and weakness on a 10 point scale.

Following APT, 21 patients (55%) returned to work while 13 required surgical diskectomy an average of 1.4 months later. Four other patients who declined surgical intervention, never returned to work.

The incidence of residual pain, weakness, and numbness was significantly greater for patients following APT compared with surgical diskectomy. In the APT vs. surgical group, 64% compared with 31% respectively complained of back pain, while weakness remained in 12% of the APT group compared with 0% in the diskectomy group. The authors concluded that APT appeared to be less effective than surgical diskectomy in the relief of symptoms associated with disc disease, and may even prove inferior to chemonucleolysis.

PAPER 13: The Natural History of Extruded Lumbar Disc Herniations Treatred Non-Operatively: An MRI Followup Study
Saal, JA; Saal, JS; Herzog, R; Kaiser, J; Appleby, S

The MRI scans of ten conservatively treated patients with extruded lumbar discs were compared over more than a two year period. Significant alteration in the size and configuration of the discs was documented. Without alteration of the canal size or disc space height, scans showed a unique lack of residual scar formation. Forty percent demonstrated complete resolution of even massive fragments, and 50% showed a marked reduction in the size of the original extrusions. Without demonstrating significant fragment migration, the positions of the fragments were sufficiently altered to allow for resolution of nerve root displacement and thecal sac impingement.

PAPER 14: Percutaneous CT Guided Biopsy of the Thoracic and Lumbar Spine
Lospinuso, MF; Ghelamn, B; Levine, DB; O'Leary, PF; Burke, S

Axial CT guided percutaneous needle biopsies were performed in 76 patients, age two to 82. These thoracic, lumbar and lumbosacral lesions were readily defined on plain X-rays, CT, or MRI scans. Forty-three (55%) metastatic lesions, 11 infections, 12 primary tumors, and 10 with osteoporosis, degenerative disc disease, or

compressive fractures were found. The stability of the involved spinal segment was questioned in 36 of the patients studied. Ct guided biopsy of the spine therefore proved safe and effective in establishing the diagnosis while affording minimal disturbance of tissue, and avoiding instability. Of the 38 thoracic, 35 lumbar, and 4 lumbosacral biopsies performed, 86% (65 of 76) proved diagnostic.

PAPER 22: Relationship Between Duration of Spinal Cord Ischemia and Post-Operative Neurological Deficits in Animals

Owen, H; Naito, M; Bridwell, KH; Oakley, D

Utlizing somatosensory evoked (SEP) and motor evoked potential (MEP's) monitoring in 25 hogs, the relationship between the duration of spinal cord distraction with instrumentation after the loss of potentials and neurological outcome was studied. The time factor was of particular interest as one hoped to determine, how fast the surgeon must act in the clinical setting where evoked potentials have been lost.

It was found that where distraction continued for 20 minutes or more following the loss of potentials, animals demonstrated a fixed paraplegia. Furthermore, the distraction model was found to significantly differ from that obtained utilizing aortic cross clamping. For those undergoing spinal distraction, paraplegia appeared to occur over a shorter interval than with aortic cross clamping, and the deficit appeared to be integrally related to the level of mechanical compromise.

Nancy E. Epstein, MD, Editor
Joint Section on Disorders of the Spine
and Peripheral Nerves
22 South Washington Street, Suite 100
Park Ridge, Illinois 60068