



CORRECTION OF CONGENITAL KYPHOSIS USING PEDICLE SUBTRACTION OSTEOTOMY

Hossam SALAH, Youssry ELHAWARY

Summary: Seventeen patients with congenital kyphosis underwent correction using a pedicle subtraction osteotomy.

Background: These were 11 females and 6 males. The mean age at the time of surgery was 18.4 years. Two patients presented with a neurological deficit. The preoperative kyphosis angle ranged 40°-122° (mean 78°). Twelve patients were type I, 3 were type II, and 2 were type III. The operative technique involved creating a wedge in the apical body, the application of multilevel posterior instrumentation and the use of a cantilever correcting force.

Methods: The mean correction angle was 57.4° that was well maintained into the latest follow up (33 -70 months). Three complications developed in 2 patients. One developed a

partial neurological deficit 48 hours after surgery that completely recovered. Another developed an infection that required surgical debridement, only to return three months later with pull out of the proximal construct. This required revision surgery, with an uneventful postoperative course.

Conclusion: Pedicle subtraction osteotomy is a useful technique in the correction of congenital kyphosis; with preservation of the anterior cortex of the wedge, the use of a long posterior instrumentation, and the application of a cantilever corrective force, excellent results are obtained with an acceptable rate of complications. This is achieved without the added morbidity of an additional anterior approach.

* SRS Bölgesel Kursu ve Avrupa-Ortadoğu Toplantısı kongre özetleri, SRS başkanı ve Yönetim Kurulu'nun (Dr. Behrooz Akbarnia-Dr. Keith Bridwell) izniyle JTSS dergisinde basılmıştır. Gerekli iznin alınmasında katkısı olan Dr. Ahmet Alanay'a teşekkürü bir borç biliriz. JTSS Yayın Kurulu.

THE EFFECT OF MID-THORACIC VEPTR OPENING WEDGE THORACOSTOMY ON CERVICAL-THORACIC CONGENITAL SCOLIOSIS

Robert M. CAMPBELL, Jr. SMITH, JW SIMMONS, BR COFER, SC INSCORE, C GROHMAN

Purpose: Cervical thoracic congenital scoliosis can result in severe head tilt and decompensation. Treatment with traditional spine fusion/osteotomy is complex, hazardous, and causes loss of growth of the involved spine. VEPTR patients with cervical-thoracic scoliosis, surprisingly, seem to have improved clinical head alignment following mid-thoracic thoracostomy. This study was undertaken to evaluate the reason for this improvement.

Methods and Material: Patients with severe congenital C/T curves and TIS due to thoracic scoliosis and fused ribs treated with mid-thoracic VEPTR opening wedge thoracostomy were studied. Radiographs were assessed for angle of the C/T curves, the compensatory curves distally, thoracic and head decompensation, and cervical tilt.

Results: 14 patients: 8 male/6 female. Avg age at surgery was 4.04 yrs (1.5 - 12.5 yrs). Avg. F/U was 3.3 years (2-5.5 yrs). The cervico-thoracic curves avg. 76° (51°-132°) pre-implant, 59 post-implant and 56 at F/U. The

compensatory curves avg 40° pre-implant, 38° post-implant, and 33° at F/U. Head decompensation avg. 3.4 cm pre-implant, 1.0 cm post-implant, and 1.5 cm at F/U. The cervical tilt angle avg 33° pre-implant, 27° post-implant, and 26° at F/U. Frontal decompensation was 3.5 cm pre-implant, 1.1 cm post-implant, and 1.9 cm at follow-up. All spines grew in length. 5 pts had no complications. 9 pts: asymptomatic migrations - 6 rib cradles/4 spinal hooks; 2 - S hook fractures, 3 wound infections, 1 skin slough, 1 transient brachioplexopathy, 1 rib avulsion.

Discussion: The clinical improvement in alignment from mid-thoracic VEPTR opening wedge thoracostomy seems due to mostly to cervico-thoracic curve improvement rather increase in the distal compensatory curve. VEPTR mid-thoracic thoracostomy may be a way to control difficult cervico-thoracic curves in young children, allowing growth, so that definitive fusion can be preformed more safely later in life.

ORAL PRESENTATION

SURGICAL TREATMENT OF NEGLECTED CONGENITAL SCOLIOSIS VIA POSTERIOR APPROACH

Cuneyt MIRZANLI, Mehmet AYDOGAN, Ufuk TALU, Azmi HAMZAOGLU

Purpose: Purpose of this study is to evaluate the results of surgeries performed via posterior approach only for the treatment of neglected congenital scoliosis.

Materials and Methods: Thirty-two patients aged 7-29 (mean,18.3) years were operated. Seventeen of 32 patients had associated intramedullary abnormalities including diastatomyelia and tethered cord (10 patients), only tethered cord (6 patients) and retethering (1 patient). In 6 patients, correction-instrumentation and posterior fusion; in 8, posterior total or subtotal vertebrectomy; in 10, posterior pedicle subtraction osteotomy; in 7, posterior total wedge osteotomy and in 1, multiple posterior vertebral osteotomies were performed. The patients without intramedullary pathologies and who underwent to posterior correction-instrumentation and posterior fusion, traction radiography under general anesthesia was performed to evaluate the trunk imbalance necessitating posterior additional osteotomy. Treatment of intramedullary pathologies was done in all patients in the same session of anesthesia. Correction and stabilization were achieved by posterior pedicle screws.

Titanium mesh cages were used in patients with residual anterior gap and anterior column support.

Results: Average follow-up period was 4.7 (3-10) years. In three patients, the superficial wound infection; in two patients, transient lower extremity paresis was seen. The fusion was achieved in all patients and neither implant failure nor pseudoarthrosis was observed.

Conclusion: During the diagnosis and treatment planning of late diagnosed or neglected congenital scoliosis cases, excellent and high-technology neuroradiological investigations are mandatory. Especially in thoracolumbar and thoracic deformities with prominent coronal plane deformity without intramedullary pathologies, traction roentgenograms under general anesthesia helps surgical planning in terms of elimination of anterior surgery. The treatment of intramedullary pathologies in the same surgery is another advantage of this kind of surgery. However, long operation time, risk of infection and cerebrospinal fluid leakage after the operation constitute the disadvantages.

EVALUATION OF THE RESULTS OF CONCAVE RIB OSTEOTOMY IN THE CORRECTION OF THE ADOLESCENT IDIOPATHIC SCOLIOSIS CURVES

Mir Mostola SADAT, Mohammad Javad ZEHTAB, Hooman BAKHSHI, Mohsen KARARNI

Study Design: Prospective outcome analysis following Concave Rib Osteotomy (CRO) in correction of thoracic adolescent idiopathic scoliosis (AIS) curves.

Objective: To compare the correctional effect of CRO in a matched cohort of AIS patients.

Summary: Thoracic scoliosis curves produce ribs deformity that accompanying sternum make a finally rigid cage that prevent correction of scoliosis curve.

Methods: We prospectively followed the preoperative and final postoperative follow-up results of an age-and curve-matched cohort of 24 consecutive thoracic scoliosis. Twelve were treated with posterior fusion and instrumentation without CRO and twelve were treated with posterior fusion and instrumentation and CRO. All patients had a minimum 2-year follow-up. CRO was done in intermediate curvature of main thoracic curve with the same incision of the posterior fusion (range, 5-7 ribs).

Results: There was no statistically significant difference with regard to the preoperative

age of the patients, main curves, flexibility indexes of main curve, sagittal Curvature and fusion levels between two groups . Operating time averaged 170 minutes in the CRO(-) group and 190 minutes in the CRO(+) group (P value: 0.08). Average intraoperative blood loss was 1223 ml. in the CRO(-) group and 1300ml. in the CRO(+) group (P value: 0.1). After surgery, average major curve correction was 69.5 % in the CRO(-) group and 78.7 % in the CRO(+) group (p value, 0.007). There were two pneumothorax detected postoperatively in which one needed chest tube insertion. There was not any chest wall pain at final follow-up visit in the CRO(+) group.

Conclusion: By considering preventing effect of the deformed chest wall in corrective surgery of AIS curves, CRO provides an simple technique to perform corrective scoliosis surgery without significant difference in the operating time or intraoperative blood loss by using the same incision of posterior thoracic fusion.

ORAL PRESENTATION

THE EFFECTS OF CONCAVE RIB OSTEOTOMY ON PULMONARY FUNCTION IN PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

Abla Mohamed Hamed SALEH, Youssry Kamal EI HAWARY, Mohmamed EI MASRY

Subjects: A prospective study of 127 patients who underwent posterior spinal arthrodesis and segmental spinal instrumentation with iliac crest bone graft for correction of adolescent idiopathic scoliosis. Patients were divided according to their Cobb angle into two groups. Group 1 (n= 78) with a Cobb angle >70 who underwent an additional concave rib osteotomy (CRO) and group 2 (n= 49) with a Cobb angle <70 who did not (NCRO). All patients received pulmonary rehabilitation program postoperatively. Vital capacity [VC] and peak expiratory flow rate [PEF] were measured pre-operatively, at 3 months and 12 months postoperatively.

Summary: Concave rib osteotomy technique is used for giving more mobility and flexibility of the spine during correction especially in rigid and severe curves. Only a few studies in the literature have looked at the effect of concave rib osteotomy on pulmonary function.

Results: - *Curve correction:* The mean Cobb angles at the preoperative and final follow up for group-1(CRO) were 82.2° and 10.9° respectively (87 % correction). In group-2 (NCRO), the mean Cobb angle was 62.77 % preoperatively and 6.9 % at the final follow up (89% correction achieved).

- *Pulmonary function: Preoperative:* There was no significant difference between the 2 groups; 3 Months Postoperative: The mean VC was 40.4 % in group 1 & 48.05 % in group-2 [p=0.05]. The mean PEF was 27.38 % in group 1 & 34.1% in group 2. [p = 0.02];

12 Months Postoperative: The mean VC in group 1 was 102.4 % versus 103.5 % in group-2 [p = 0.43]. The mean PEF in group-1 was 76.2 % versus 73.5 % in group 2 [p = 0.32]

Conclusions: Concave Rib Osteotomy technique has a definite effect on the pulmonary function in the immediate postoperative period. However, this difference resolves with time and both groups had a similar outcome a year postoperatively.

VERTEBRECTOMY OR TRANSPEDICULAR OSTEOTOMY AND INSTRUMENTATION VIA POSTERIOR APPROACH ONLY IN PEDIATRIC SPINAL DEFORMITIES

Omer KARATOPRAK, Ufuk TALU, Mehmet TEZER, Azmi HAMZAOGLU

Introduction: Vertebrectomy and instrumentation via posterior approach only is being increasingly used especially in the surgical treatment for sagittal plane deformity. This approach is also useful in combined, sagittal and frontal plane deformities. Purpose of this retrospective study is to evaluate the clinical and radiological results of (hemi) vertebrectomy and instrumentation only via posterior approach in various pediatric spinal deformities and pathologies.

Materials and Methods: Between the years of 1998 and 2002, 29 patients had vertebrectomy and interbody fusion using posterior instrumentation with or without titanium mesh cage (TMC) via only posterior approach. Of those 19 were pediatric patients. Deformity was due to congenital malformation in 15 (2 scoliosis, 5 kyphosis, 8 kyphoscoliosis), Ehlers-Danlos Syndrome in one, mucopolysaccharidosis in one, posttraumatic kyphosis in one and neurofibromatosis in one patient. The age of the patients ranged from 2 to 15. All patients had one or two level vertebrectomy via posterior approach (5 thoracal, 8 thoracolumbar, 6 lumbar). TMC was used for anterior co-

lumn support and interbody fusion in patients who had residual anterior gap preventing bone to bone contact. Correction and stabilization were achieved by posterior pedicle screws.

Results: Average follow-up is 2.8 (2-5) years. We did not state any loss of correction, pseudoarthrosis, TMC collaps or implant failure. We had one superficial infection which responded well to debridment and antibiotics, one incomplete left lower extremity paresia due to dural buckling and complete recovery was achieved. Three months after revision surgery, three acute transient pancreatitis and one acute tubular necrosis with complete recovery. All these complications were in congenital deformity patients.

Conclusion: Although longer follow up is needed vertebrectomy and instrumentation via posterior approach only is a good one-stage surgical treatment option which avoids the surgical trauma and morbidity related to anterior surgery. However, it is a demanding surgical procedure requiring extreme care and experience in spine surgery.

ORAL PRESENTATION

IMPLICATION FOR MELATONIN AND ITS RECEPTOR IN THE SPINAL DEFORMITIES OF HEREDITARY LORDOSCOLIOTIC RABBITS (LSR)

Satoshi SOBAJIMA, Akihiro KIM; Ichiro BABA; Kiyoto KANBARA; Yoshihiro Munaeki ABE

Study Design: The relationship between melatonin system and the spontaneous development of the spinal deformities in LSR, the natural animal model for idiopathic scoliosis, was studied.

Objectives: To examine the implication for melatonin and its receptor in the spinal deformities of the natural animal model, Hereditary Lordoscoliotic Rabbit (LSR).

Summary of Background Data: We previously reported radiological and histological studies investigating the etiology of spinal deformities in a breed of Japanese White Rabbit, the Hereditary Lordoscoliotic Rabbit (LSR). These animals develop thoracic lordoscoliosis during growth and as such can be used as a model for human idiopathic scoliosis. White previous studies in chickens have established that pinealectomy produces scoliosis, the cause of the condition is yet to be fully elucidated.

Methods: Serum melatonin levels in LSRs were measured by RIA and compared with those of Japanese White rabbits (Controls).

The expression of melatonin receptor in the rabbit was detected by homology cloning in order to access the number of the melatonin receptor mRNA in the rabbit spinal cord by quantitative RT-PCR.

Results: Serum melatonin levels in LSRs were significant higher than those of controls in each period until 20 weeks. We detected the expression of melatonin receptor mRNA in rabbit spinal cord. However, no significant quantitative differences in the level of expression of melatonin mRNA in the spinal cord between LSRs and controls.

Conclusions: In relation to the present study, we suggest that causes of spinal deformities in LSR may be due to the contribution of melatonin receptors as well as that of altered serum melatonin levels in LSR. Further studies will be required to investigate the expression of melatonin receptor in other tissues of LSR as well as to delineate the role of melatonin in the pathogenesis of idiopathic scoliosis.

EXPRESSION OF COMPONENTS OF THE FGF SIGNALING PATHWAY IN POSTNATAL MOUSE VERTEBRAL GROWTH PLATE

Atiq A. DURANI, Chitra L. DALIA, Eric MAHONEY, Christopher WYLIE

INTRODUCTION: Idiopathic scoliosis is the most common type of spinal deformity. It is thought to occur from unsynchronized growth of the vertebral growth plates.

AIM: The goal of this study is to find out how cell signaling pathways control symmetrical growth of vertebrae during postnatal life.

METHODS: FVB mice were selected from 1-9 weeks of age and their longitudinal growth was determined by measuring the lengths of the mice at one-week intervals. Vertebra and knee joints were removed from 1-4 weeks old male mice and immediately frozen. 10 μ m cryosections in the coronal plane were collected from the thoracic vertebrae and knee joints, and histological analysis was carried out by staining with hematoxylin and eosin. Immunolocalization of FGF-2, the activated form of FGFR, and its downstream signaling molecule, the di-phosphorylated form of ERK 1/2 [Di(p)-ERK1/2] was carried out on cryosections.

RESULTS: Maximum longitudinal growth of the mice was observed between 1-4 weeks of age. Histological analysis of the vertebrae and tibia revealed the spatial organization of

the chondrocytes in the growth plate. Immunolocalization revealed that FGF-2, the active form of FGF, was found in the late proliferating and hypertrophic chondrocytes layer. The activated receptor for FGF (Fig. A & B) as well as its downstream signaling molecule was observed only in the hypertrophic and apoptotic chondrocytes in both vertebral and tibial growth plates.

INFERENCE: Active signaling of FGF in the hypertrophic and apoptotic zone of the vertebral growth plate suggests its involvement in the hypertrophy and apoptosis of chondrocytes which then leads to the ossification of the matrix laid down by the growth plate chondrocytes.

SIGNIFICANCE: Understanding the molecular biology of postnatal vertebral growth plate development will allow future understanding of the defect(s) that cause scoliosis and will lead to development of novel therapies for management of these growth related disorders.

Expression of FGFR in mouse vertebral (A) and tibial (B) growth plate.

ORAL PRESENTATION

**THE EFFICACY OF CORRECTION OF RIGID NEUROFIBROMATOSIS
DEFORMITIES USING THREE DIMENSIONAL INSTRUMENTATION
AUGMENTED WITH SUBLAMINER WIRES**

Wael KOPTAN, Hazem EISEBAIE, Yasser EIMILGUI

Study Design: Of 17 patients with dystrophic spinal deformity resulting from neurofibromatosis who were treated surgically between 1997 and 2002.

Objectives: To study the efficacy of correction of these rigid neurofibromatosis deformities using three dimensional instrumentation augmented with sublaminar wires.

Summary of Background Data: The surgical management of dystrophic spinal neurofibromatosis is a demanding procedure with uncertain results. Several difficulties are present in such patients including the poor bone stock and the angular nature of these curves.

Methods: All patients had a two staged procedure; an anterior release followed one week later by posterior instrumentation augmented by sublaminar wires. The wires were

placed immediately below the proximal anchor and several sublaminar wires at the apex of the deformity.

Results: The mean Cobb angle of the main curve was 62.2° before surgery which was corrected to an average of 29°. Patients were followed-up for at least 2-years. The loss of correction had an average of 5°.

These results were compared to the literature and were found to be equal with a less amount of loss of correction.

Conclusion: The use of extensive and vigorous anterior release with posterior sublaminar wires has proved useful and effective in the treatment of these difficult cases, improving the correction achieved and decreasing implant related complications.

COMBINATION OF LUQUE INSTRUMENTATION WITH SCREWS IN TREATMENT OF MYELOMENINGOCELE KYPHOSIS

Selim YALCIN, Baris KOCAOGLU, Ahmet Hamdi AKGULLE, Bulent EROL

Introduction: Most investigators agree that kyphotic deformity in myelomeningocele should be treated with vertebral resection. Vertebral osteotomy with insertion of poly-axial screws at the lumbar site in combination of segmental spinal instrumentation by Luque technique has been the author's procedure of choice.

Materials and methods: Between June 1997 to June 2003, 22 patients who had a myelomeningocele and severe kyphotic deformity were operated with resection of the lordotic segment at the apical site. The later 7 out of 22 were operated with a new technique. There were 3 female and 4 male patients. The average age at the time of the operation was 7,1 (range: 6-9). All patients were available for follow-up, with a minimum of 24 months and average follow-up of 35.1 months (range: 24-48 months). Poly-axial screws were used posterolaterally in combination of segmental Luque instrumentation which was wired to the

thoracic spine and anterior to the sacrum.

Results: Kyphotic deformity averaged 104° (range: 85°-120°) before the surgery, 15,2° (range: 10°-35°) after the surgery and 18,5° (range: 10°-40°) at the latest follow up. The loss of correction was 3, 3° (range: 0°-5°). The average blood loss was 611, 4 ml (range: 230-1500). Complications occurred in 2 of 7 patients which were superficial wound breakdown and deep wound infection that required rotational flap closure.

Conclusions: Kyphectomy with posterior instrumentation by using Luque technique with the combination of poly-axial screws is an alternative method of correcting rigid kyphotic deformity in patients with myelomeningocele. Rigidity of the construct, greater correction capacity and low profile instrumentation by the help of posterolateral insertion of the poly-axial screws and wiring were the distinct advantages of this technique.

ORAL PRESENTATION

THE EFFECT OF PEDICLE EXPANSION ON PEDICLE MORPHOLOGY AND BIOMECHANICAL STABILITY IN THE IMMATURE PORCINE SPINE

Muharrem YAZICI, Murat PEKMEZCI, Akin CIL, Ahmet ALANAY, Emre ACAROGLU, F. Cumhur ÖNER

Purpose: Pedicle screws have become the implant of choice in spinal fixation. Secondary to the small vertebra sizes of pediatric patients and difficulty in finding appropriate screw sizes, they found limited use in pediatric spine. Dilation of the pediatric pedicles may overcome the limitation secondary to discrepancy between screw sizes. However, there is no data in the literature regarding dilation capacity of pediatric pedicles to enable larger pedicle screw fixation. The aim of this study is to evaluate the feasibility of sequential dilation of the immature pedicles by dilators and to determine the biomechanical stability of screws placed in these expanded pedicles.

Methods: Two-month-old domestic pig vertebrae were used. The vertebra were dissected off their soft tissues and split into equal halves. The right pedicles were dilated with stainless steel dilators just before there is vi-

sual evidence of pedicle failure. The left pedicles served as control group. The inner and outer diameters of the pedicles were measured on the CT scans before and after dilation. The hemivertebrae were embedded into acrylic cement and the pedicles were instrumented with 3.5 mm pedicle screws at thoracic level and 4.0 mm pedicle screws at lumbar level. The pull out strength of each screw was measured with a materials testing machine.

Results: The dilation procedure resulted in an increase in both inner ($2.59\pm 0.75\text{mm}$ to $3.32\pm 0.58\text{mm}$) and outer diameters ($5.43\pm 0.95\text{mm}$ to $6.21\pm 0.96\text{mm}$) ($p<0.01$).

Conclusions: This study demonstrated that immature pedicles can be expanded by application of serial dilators. However, dilation significantly decreases the pull out strength of the pedicle.

COMPARISON OF VERTEBRAL PURCHASE STRENGTH FOR SEGMENTAL TRANSLATION OF PEDICLE SCREWS, SUBLAMINAR WIRES, PEDICLE HOOKS AND ANCHORED PEDICLE HOOKS AGAINST 45-DEGREE POSTEROLATERAL PULL-OUT FORCES

Nazir Cihangir ISLAM, Ensor TRANSFELDT, Thomas STEFFEN,
James D. SCHWENDER, Lara COHEN

Introduction: Anchoring of pedicle hooks to the lamina or endplate provides improved stability and increased pull out strength. Studies compared anchored pedicle hooks to standard pedicle hooks as well as pedicle screws against posteriorly directed pull out force. However, scoliosis correction creates a posterolateral resultant force. The goal of this study was to perform mechanical testing simulating the posterolateral force created with the translational correction of scoliosis.

Methods: After the measurement of BMD, 26 fresh frozen human cadavers were instrumented with Colorada Pedicle Hook (CPH), CPH-Staple (CPHS), USS-Pedicle Hook (USSPH), Colorado Pedicle Screw (CPS), and Luque Sub-Laminar Wire (LSL W) in the unconstrained but only the hooks were used in the constrained study. Pull outs were performed in 450 posterolaterally with MTS Mini Bionix Model Machine. The lower platform was free in all movements in horizontal plane in unconstrained but blocked during the constrained part of the study. The upper arm restricted only rotation in the unconstrained but per-

mitted only for hinge movement around the rod during the constrained part of the study.

Results: Load Displacement Curves (LDC) of CPH and CPHS showed similar characteristics as observed in CPS and USSPH. Differences in failure forces among CPHS (430 ± 118), USSPH (603 ± 328), and CPS (592 ± 293) were insignificant, however, LSL W (788 ± 290) and CPH (175 ± 93) were significantly different from others in unconstrained part of the study. In the constrained part, no difference was observed between CPHS (442 ± 164) and USSPH (560 ± 213). Only CPH (288 ± 189) increased its strength.

Conclusion: LDC of CPH and CPHS shows that the latter maintains its hook properties but increases its strength with addition of the staple however USSPH resembles CPS. While CPHS and USSPH were showing significantly higher strength than CPH during the unconstrained pullouts they maintained their strength and failure patterns in constrained system. CPH and CPHS didn't violate the neural structures during pull outs.

ORAL PRESENTATION

SELECTIVE FUSION WITH SEGMENTAL PEDICLE SCREW FIXATION IN SINGLE THORACIC IDIOPATHIC SCOLIOSIS

Patrizia PARISINI, Mario DISILVESTRE, M. BAKALLOUDIS, G. Lolli Ma

Objective: A retrospective study.

Materials and Methods: Our study included 28 patients (25 females, 3 males) with single thoracic adolescent idiopathic scoliosis (Lenke type- 1A: 10, type-1B: 18), surgically treated from 1998 to 2003 using pedicle screw instrumentation. The average age at operation time was 16.3 years. The lowest instrumented vertebra corresponded to one level shorter than the stable vertebra in 10 cases, to two levels shorter in 10, to three levels shorter in 3 and to the stable vertebra in 5 cases.

Results: (Average follow-up of 3.2 years: range, 2.2 to 4.2) The mean pre-operative thoracic curve of 64.1° was corrected to 20.6° at follow-up (correction of 67.8 %). The mean thoracic apical vertebral translation (AVT) showed a correction of 75.5 %, from pre-operative 4.9 cm to 1.2 cm at follow-up. The lumbar curve had a spontaneous correction from the mean pre-operative value of 38.1° to 18.1° at

follow-up (52.4 % of correction). Out of 420 thoracic screws, 6 of them (1.6 %) were found to be misplaced without consequences. We observed 5 cases (17 %) with unsatisfactory radiographic results. In one case (Lenke IB: King III) there was an excessive correction of the thoracic curve. In the other four patients (Lenke IA: King IV) the distal fusion level was performed two or more levels proximal to stable vertebra.

Conclusions: In thoracic curve King IV or Lenke 1A type, the distal fusion level shorter two or more levels than stable vertebra has a high risk of postoperative adding on phenomenon. In thoracic curve Lenke-1B or King III type, the distal fusion level shorter one or two levels than the stable vertebra showed good results. In Lenke-1B curves the excessive correction of thoracic curve can be cause of postoperative trunk decompensation.

EARLY SURGICAL TREATMENT FOR SPINAL DEFORMITIES IN PATIENTS YOUNGER THAN 10 YEARS

Mario DISILVESTRE, Patrizio PARISINI, Tiziana GREGGI, Alberto CIONI, Stefano GIACOMINI, Georgos BAKALLOUDIS, Francesco LOLLI

Objective: A retrospective study of early and aggressive surgery for early onset spinal deformities

Methods: This study included a consecutive series of 35 patients (13 males, 22 females) aged at operation time 6,1 years (range, 1 to 10).

Twenty-six cases underwent a planned anterior and posterior surgery; in two cases we performed an "in situ" arthrodesis whereas the remaining 7 patients were treated by a posterior fusion and using pediatric segmental instrumentation.

Results: At an average follow-up of 4 years (range: 2 to 9 years) we observed that in 16 patients treated by planned anterior convex epiphysiodesis and posterior instrumentation, 15 showed no progression and 1 a mild progression of deformity.

In the 8 cases treated by planned anterior hemivertebra resection and posterior instrumentation we observed solid fusion in all; the remaining 2 particular cases (1 cervical kyphosis due to neurofibromatosis and 1 sacrum agenesis) were both treated by planned anterior fusion and posterior instrumentation resul-

ting in stable fusion. Both patients treated by an "in situ" arthrodesis registered a severe progressions of the deformity.

For the 7 cases treated only by posterior instrumented fusion we found in 3 a mild progression and in 1 a severe progression of deformity. We performed 10 revision procedures, worth mentioning the fact that 7 occurred to the posterior only group.

We observed only one neurological complication in a 2 years old girl presented a severe postoperative paraparesis.

Conclusions: Planned anterior convex epiphysiodesis or hemivertebra resection supplemented by posterior segmental instrumentation, can control curve progression in early onset spinal deformities better than previous techniques, such as in situ posterior fusion and subcutaneous instrumentation. The present experience confirms that the progression of severe, early onset spinal deformities which are often a result of congenital or infantile scoliosis, can be avoided through early and aggressive surgery, even in very young children.

ORAL PRESENTATION

EVALUATION OF SINGLE GROWING ROD WITH PROXIMAL DOUBLE CLAW CONSTRUCT FOR EARLY ONSET SPINAL DEFORMITIES

Hazem EL SEBAIE, Yasser EL MILIGUI, Wael KOPTAN

Study Design: A technical report evaluating the results of a newly described construct aiming to add stability for the single rod growing instrumentation.

Objectives: To evaluate the outcome of this technique, amount of correction achieved and associated complications in the management of paediatric spinal deformities from different etiologies.

Summary of Background Data: The choice of using dual or single growing rods has been controversial in this evolving procedure. Changing the configuration of the construct leads to variation in the overall results.

Methods: Eleven patients with progressive pediatric scoliosis (idiopathic, congenital, syndromic and neurofibromatosis) underwent instrumentation without fusion using a novel construct consisting of a single rod, proximal double claw construct and distal pedicle

screws. The average age at surgery was 5 years 9 months. The preoperative curve measured an average of 74°. All patients had posterior instrumentation with five patients having anterior annulotomy one week beforehand.

Results: The average curve immediately after surgery was 36° and at the final follow up the curves measured 40° over a minimum follow up period of 2y 2m during which an average of 5.3 distractions/ patient were done. Over the course of treatment, implant related problems complicated 6 out of 70 procedures. Two unplanned surgeries were done for complications occurring during the follow up period.

Conclusions: The use of this novel construct in single growing rods improves the amount of correction, increases stability and decreases the incidence of proximal construct pull out in comparison to previously reported single growing rod results.

COMPLICATIONS OF DUAL GROWING ROD TECHNIQUE IN EARLY ONSET SCOLIOSIS: CAN WE IDENTIFY RISK FACTORS?

Behrooz A. AKBARNIA, Marc A. ASHER, Ramin BAGHERI, Oheneba BOACHIE-ADJEI, Sarah K. CANALE, Patricia N. KOSTIAL, David S. MARKS, Richard E. MCCARTHY, Michael J. MENDELOW, Connie POE-KOCHERT, Paul D. SPONSELLER, George H. THOMPSON

Purpose: To identify factors influencing complications in patients with early onset scoliosis (EOS) who underwent the dual growing rod technique.

Methods: Between September 1987 and August 2003, 48 patients with EOS underwent initial surgery and had a minimum of 2 years follow-up, with 29 patients developing complications. Complications were divided into 4 groups: implant, wound, alignment, and general. Relations analyzed included age at surgery, diagnosis, curve magnitude, initial correction, follow-up length, and lengthening frequency.

Results: Fifty-five complications occurred in 29 patients. Twenty-seven implant, 14 wound, 5 general and 9 alignment-related complications occurred. Eighteen complications resulted in 23 unplanned procedures. Thirty-seven complications were addressed during planned procedures. Average age of the uncomplicated group was 81.9 mos and 61.5 mos in the complicated group. Average follow-up of the uncomplicated group was 46.6 mos compared to 67.1 mos in the complicated group. Average interval between lengthenings was 8.1 mos (uncomplicated group) versus

11.8 (complicated group). Both groups had an average Cobb angle $>70^\circ$ prior to initial surgery. Diagnosis was insignificant except for Infantile Idiopathic Scoliosis (IIS), where 8 of 9 total patients had implant-related complications. The implant complication group had 5 of 27 complications requiring unplanned surgeries. Six deep infections occurred. Additionally, 2 of 3 wound problems evolved into deep infections and 2 of 4 superficial infections became deep.

Conclusion: At initial surgery, younger patients had higher complication rates. More complications occurred with longer treatment periods. Most implant problems were addressed during planned surgeries. High correlation existed between diagnosis (IIS) and implant-related problems. Patients whose lengthening intervals were ≤ 7 mos had fewer implant complications but more wound complications. Patients whose intervals were ≥ 7 mos had more implant complications but fewer wound complications. Wound problems should be addressed aggressively to prevent deep wound infections. This technique has a high but manageable complication rate.

ORAL PRESENTATION

TRANSPEDICULAR EXPANDED EGGSHELL TECHNIQUE VERTEBRAL COLUMN RESECTION FOR SERIOUS RIGID KYPHOSCOLIOSIS IN ADULTS

Yan WANG, Xuesong ZHANG, Zheng WANG

Objectives: To report a technique of transpedicular expanded eggshell technique vertebral column resection (VCR) through a single posterior approach and its preliminary results in the treatment of severe congenital rigid kyphoscoliosis to adults.

Summary of Background Data: Transpedicular eggshell osteotomies and vertebral column resection is a formidable operation reserved for rigid severe deformities. The authors devised a technique combined two techniques in treatment of adult congenital kyphoscoliosis through a single posterior approach.

Methods: Sixteen serious rigid congenital kyphoscoliosis deformity adult patients were reviewed, who were treated by posterior transpedicular expanded eggshell technique VCR, 6 males and 10 females with a mean age of 31.8 (range 21.5-44.2 years old). Three-dimensional reconstructive images were used for preoperatively osteotomy levels selecting and accurately pedicle screws placing. The surgery consisted of one-stage posterior transpedicular eggshell technique, and then

expanded the eggshell to the adjacent intervertebra space, range of resection of the vertebral column at the apex of the deformity, including AV and both cephalic and caudal adjacent wedge vertebra. Posterior elements were removed, after completion of the VCR, closure was obtained by gradually cantilever and compression technique.

Results: Average 1.6 vertebra were resected. Mean operation time was 256 min with average blood loss of 2250 ml. Mean 32 mm shorten was measured during operation, and 22 mm lengthen in standing post-operation. In this group, average follow-up was 2.6 years (range 2.1-3.5 years). Deformity correction was 52.3 % in the coronal plane and 75.1 in the sagittal plane. Complications were encountered in 4 patients: 2 transversal spinal injury and 2 root injuries (all incomplete).

Conclusions: Posterior transpedicular expanded eggshell technique VCR is an effective alternative for serious congenital rigid kyphoscoliosis in adults.

CERVICAL OSTEOTOMY IN ANKYLOSING SPONDYLITIS: EVALUATION OF NEW DEVELOPMENTS

Danielle LANGELOO, DD LANGELOO, HL JOURNEE, M. DEKLEUVER

Objectives: Here we study the role of two new developments in cervical osteotomy in patients with cervical kyphosis due to ankylosing spondylitis: internal fixation and subsequent avoidance of a halo-cast, and improved applicability of transcranial electrical stimulated motor evoked potential monitoring (TES-MEP).

Methods: From 1999-2004, 16 patients underwent a C7-osteotomy with internal fixation. In 11 patients, cervical osteotomy was performed in a sitting position with halo-cast immobilization (group-S), 5 patients underwent surgery in prone position with Mayfield clamp fixation (group-P) with post-operative immobilization by cervical orthosis. TES-MEP was applied using one reference bilateral recording site above the surgical level (trapezius muscle) and 3 bilateral recording sites below the surgical level. To reduce disturbing stimulus artifacts, the iso-potential lines of these electrical stimulus artifacts were determined in an experimental setting.

Results: Consolidation was obtained in all patients without loss of correction. One patient died 6 weeks post-operatively. In-group-P,

longer fusion towards T4-T6 could be obtained that created a more stable fixation. TES-MEP was successfully performed during all surgeries. In total, 9 neurological events were registered. Additional surgical intervention resulted in recovery of amplitudes in 6 of 9 events. In two patients spontaneous recovery took place, in one patient a partial C6 spinal cord lesion occurred. At the TES-MEP trapezius muscle recordings, stimulus artifacts occurred in 2 patient. By placing the recording electrodes on the iso-potential lines, improved recording could be achieved by approximately 65 %.

Discussion: The results of this case-series illustrate the vulnerability of the spinal cord and the high physiological demands on patients we conclude that C7 osteotomy with internal fixation has been shown to be a reliable and stable technique. When surgery is performed in prone position, distal fixation can be optimally obtained allowing post-operative treatment by cervical orthosis. TES-MEP monitoring has been shown to be a reliable neuromonitoring technique and of high clinical relevancy.

ORAL PRESENTATION

PRE AND POST-OPERATIVE ANALYSIS OF LUMBOSACROPELVIC JUNCTION RADIOLOGICAL PARAMETERS IN PATIENTS WITH SEVERE LOCALIZED KYPHOSIS

Olcay GULER, Ufuk TALU, Cuneyt SAR, Azmi HAMZAOGLU, Unsal DOMANIC

Introduction: Radiological parameters related to the sagittal balance of the spine and lumbosacropelvic junction in healthy individuals have been extensively analyzed and normal range of values have been defined. However, to our knowledge, these parameters have not been investigated in a population of patients with a pure sagittal plane deformity. Thus, the purpose of this study is to focus on the compensatory changes in these parameters in response to a kyphotic deformity and results after corrective surgery and restoration of sagittal balance.

Methods: All positional [local kyphosis (LK), cervical lordosis (CL), thoracic kyphosis (TK), lumbar lordosis (LL), sagittal plumb line (PL), pelvic tilt (PT), sacral slope (SS), lumbosacral angle (CLSA), LS- incidence angle (ILS), pelvic-radius SI angle (PRSI)] and anatomic [sacral inclination angle (SI), pelvic incidence (PI)] radiological parameters were measured by two independent spine surgeons in 20 patients with severe, angular, lower thoracic or thoracolumbar kyphotic deformity before and after corrective spine surgery. The average age was 30.4 (18-48) and minimum follow-up was 2 years. Statistical analysis were per-

formed by paired t-test with significance at $p < 0.05$.

Results: Pre and postop average LK at lower thoracic or TL spine was 62.6° (19° - 120°) and 14.9° (-7° - 70°) respectively. Pre and postop measurements for the parameters that were affected by the deformity and changed for compensation were found as follows. Preoperatively; CL: -26.4° (-75° - 20°), PT: 9.7° (-18° - 38°), SS: 27.6° (-3° - 48°), LSA: 19.8° (5° - 34°), ILS: 11.4° (-10° - 48°), PRSI: 41° (7° - 64°), SI: 43° (22° - 64°), PI: 36.2° (7° - 82°). Postoperatively; CL: -26.9° (-59° - 20°), PT: 11.3° (-7° - 38°), SS: 30.2° (13° - 52°), LSA: 16° (5° - 28°), ILS: 15.5° (-2° - $S2^\circ$), PRSI: 45.2° (9° - 70°), Si: 46.3° (34° - 66°), PI: 41.1° (16° - 80°). There was no statistically significant difference in the pre and postop measurements of lumbosacropelvic junction radiological parameters.

Conclusion: Despite significant correction of the deformity and statistically significant differences in average pre and postop LK, TK and LL, there are no significant adaptive changes in lumbosacropelvic junction radiologic parameters after surgical correction in patients with severe thoracolumbar kyphotic deformity.

THE IMPORTANCE OF PELVIC INCIDENCE IN DETERMINING A RELAVANT PARAMETER IN SAGITTAL BALANCE OF THE SPINE

Khalil KHARRAT, Gaby KREICHATI

Study design: This is a retrospective chart review of patients with fixed flat lumbar spine operated by lumbar osteotomies to restore their sagittal balance.

Purpose: To evaluate the reliability of the parameter Pelvic Incidence to determine the amount of lumbar lordosis needed for restoring and preserving the sagittal balance of a patient operated by correction of his fixed lumbar spine.

Summary of background data: Lumbar Lordosis is not a fixed figure for all people. Its amount is specific and particular to each individual. Mrs Duval-Beaupere showed a relation between Pelvic Parameters: Pelvic Incidence, Pelvic Tilt, Sacral Slope and the Sagittal Spine Parameters particularly Lumbar Lordosis

Introduction: In case of correction of a fixed flat back, the problem is to know what is the amount of Lumbar Lordosis we need to obtain for the patient we operate, to restore and preserve his sagittal balance.

Material: Twelve patients operated on for fixed unbalanced sagittal spine were reviewed.

- Five flat back after Harrington instrumentation.
- Six Ankylosing Spondylitis.
- One severe rheumatic disease.
- F-up was from 2 to 8 years to all patients but one with 1 year F-up

Methods: The methods used were: 7 Posterior Osteotomies, 4 Trans pedicular osteotomies and 1 Posterior vertebral column resection.

The first eight cases were operated without any referral to the sagittal parameter of Mrs. Duval Beaupere: Pelvic incidence, Pelvic tilt, Sacral slope and lumbar lordosis.

The 4 last cases were operated with a meticulous referral to these parameters which allow us to restore a Lumbar Lordosis according to the Pelvic Incidence of the patient.

Results: The quality of the results we had is very different depending on the period of time we have done this surgery. For the eight first patients the sagittal plan restored was not ideal. Imbalance increases in four of the eight patients at the last follow-up.

For the last 4 patients, in whom the Lumbar Lordosis restored corresponded to the Pelvic Incidence of the patient, the Sagittal Balance of the patient was well restored and preserved at the last follow-up.

Conclusion: The Sagittal Parameters of Mrs. Duval-Beaupere: Pelvic incidence, Pelvic tilt, Sacral slope and lumbar lordosis are relevant means for restoring and preserving the sagittal balance of spine for patients with fixed flat back operated by lumbar osteotomies.

ORAL PRESENTATION

**PERCUTANEOUS TRANSPEDICULAR FUSION WITH AGF IN THE
TREATMENT OF TRAUMATIC VERTEBRAL FRACTURES**

Viviana Franca PALIOTTA, Benedetto MAGLIOZZI, Lucio ALESSANDRO

Background: Authors present their experience in percutaneous transpedicular fusion with AGF, AlloMatrix Purpose Injectable Putty and cancellous chips allograft combined in the treatment of traumatic compressive vertebral model. fractures (VCFs).

Methods: 12 traumatic compression vertebral fractures at "risk of kyphosis were treated by means of vertebroplasty with AGF, AlloMatrix Injectable Putty (Wright Medical Technology, Inc, Arlington, Tenn) and cancellous chips allograft. Mean age was 29 years, mean follow-up 27 months. Orotracheal intubation was needed only in the cases of upper thoracic vertebral fractures (5 patients). In lumbar and lower thoracic spine fractures peridurale anesthesia was preferred. Patients were ambulant just a few hours after operation

and they were discharged on 2nd day with a cast for 30 days. In all cases X-ray and CT were performed on 45th day, 3rd and 6th month after surgery.

Results: Fusion was early reached in all patients. Clinical outcome was favorable in all patients but one who prevent complained persistent back pain. No major complication was observed. Average 2 correction loss was observed at 2 years follow-up.

Conclusions: In selected cases percutaneous transpedicular fusion with AGF and AlloMatrix Injectable Putty seems to be an excellent method of treatment in compressive vertebral fractures even though further studies and more detailed statistical validation are needed.

INHIBITION OF SPONTANEOUS SPINAL FUSION BY USE OF ADCON-L AND 5-FU IN RAT MODEL

Esat KITER, Ertan ER, Nilay SEN, Murat OTO

Purpose: To determine the efficiency of Adcon-L and 5-FU in inhibiting spontaneous fusion in vertebra rat model.

Methods: 3 groups, each containing 10 rats were studied. L4-L5 segments of the each rat spine were opened with sharp periosteal stripping by scalpel but without decortication, and vertebral internal fixation with interspinous were done in all rats. Adcon-L and 5-FU were applied for the first and second groups, respectively. Third group was considered as the control group and no chemical were given. All 30 rats were sacrificed at postoperative 28th and total excision of the vertebral block is done respectively. The manual findings were evaluated to show the degree of the spontaneous fusion. New bone formation, fibroblast density, number of inflammatory cells and new

vessel formation were examined histopathologically.

Results: According to the manual examination findings Adcon-L showed statistical significance in preventing fusion in contrast to histological examination.

Discussion: Although manual examination findings revealed an advantage for Adcon-L in the inhibition of vertebral spontaneous fusion in our rat model, this finding was not supported histopathologically. This may be attributed to the subjectivity and low reliability of the manual examination since examined area is too small. So we can conclude that, 5-FU is useful in preventing spontaneous fusion and fibrosis since it prevents new bone formation and decreases the number of fibroblasts and inflammatory cell number in our rat model.

ORAL PRESENTATION

THE OSTEOINDUCTIVE PROPERTIES OF NELL-1 IN A RAT SPINAL FUSION MODEL

Jeffrey WANG, Steven S. LU, Xinli ZHANG, Paul TSOU, Benjamin WU, Chia SOO, Kang TING

Background: BMP-2 and BMP-7 are currently approved for human use but are associated with various adverse effects including ectopic bone formation and local inflammatory reaction. Nell-1 is a novel secretor molecule that appears to act more specifically on osteoblasts than the BMPs, which can act on multiple cell types. From a molecular point of view, Nell-1 is directly regulated by runt-related transcription factor 2 (Runx2/Cbfa1) a master regulatory gene controlling bone formation. We hypothesize that Nell-1 may also effectively form bone in spinal fusion.

Study Design: Two groups of 24 athymic rats underwent posterolateral intertransverse process spinal fusion at L4-L5 with implanted demineralized bone matrix carrier (DBM) containing either adenovirus coding for Nell-1 (Ad-Nell-1) or control, Lac Z (AdLacZ). Four rats were sacrificed at 4 weeks to assess intervertebral bone development. The remaining twenty rats were sacrificed at 6 weeks for evaluation of spinal fusion.

Methods: All animals underwent Faxitron radiographs at 2, 4 and 6 weeks, manual spine palpation at 6 weeks, and high resolution MicroCT at 6 weeks. New bone formation was assessed by histology using H&E and Masson trichrome staining on decalcified coronally sectioned spine segments.

Results: All differences achieved statistical significance. After 6 weeks, direct application of adenoviral Nell-1 in a DBM carrier achieved significantly higher rates of spinal fusion over Lac Z controls: 60 % Nell-1 vs. 20% Lac Z by manual palpation and 70 % Nell-1 vs. 20 % Lac Z by micro CT and histology. Histological assessment of bone quality and maturity revealed more mature, higher quality bone in all the Nell-1 treated specimens relative to Lac Z at 4 and 6 weeks.

Conclusions: Direct application of adenoviral Nell-1 in a DBM carrier achieved significantly higher rates of spinal fusion over Lac Z controls at 6 weeks. These results indicate that Nell-1 may be a potent and specific osteoinductive molecule.

PLIF VS. POSTEROLATERAL FUSION IN ADULT ISTHMIC SPONDYLOLISTHESIS AND CHRONIC LOW BACK PAIN

Per EKMAN, Han MÖLLER, Tycho TULLBERG, Pavel NEUMAN, Rune HEDLUND

Background: Based on a RCT we have previously reported an improved outcome 2 years after posterolateral fusion (PLF) compared to exercise in adult isthmic spondylolisthesis. On theoretical grounds PLIF has been suggested to result in an improved outcome compared to PLF. Data to support this view are, however, lacking.

Purpose: To compare the outcome of PLIF with PLF in adult isthmic spondylolisthesis.

Patients: 86 prospectively followed patients, age 18-55, with symptomatic adult isthmic spondylolisthesis, operated on with PLIF, were compared to a historical control group of 77 patients operated on with PLF. The two groups had similar socio-economic, age and sex distribution, and similar level of pain and disability.

Methods: The inclusion criteria and outcome measurements were identical in the PLIF and PLF-group. The PLIF-group was operated on with autograft and carbon fibre ramps with pedicle screw fixation. The PLF-group consisted

of 77 patients operated on with PLF, 37 without instrumentation and 40 with.

Outcome measurements: Preoperatively and at 2 years follow up functional disability was quantified by the Disability Rating Index (DRI, 0-100) and the Oswestry score. Pain was quantified by VAS. The global outcome was assessed by the patient as much better, better, unchanged or worse.

Results: The follow up rate was 97 % in both groups. The mean pain, DRI and Oswestry score at 2 years follow up were similar in the PLIF vs the PLF group: pain 35 vs 37, DRI 30 vs 29, Oswestry 25 vs 25 (all ns). Similarly, the global outcome was almost identical in the two groups; 75 % of the patients in the PLIF-group classified the results as much better or better compared to 74 % in the PLF group (ns).

Conclusion: No effect of type of fusion on outcome could be demonstrated, questioning the need of anterior support in short lumbar fusions.

ORAL PRESENTATION

INCIDENCE OF SUBSIDENCE IN THE CHARITE IN LUMBAR DISC REPLACEMENT

Jorge ISAZA, Steve GULORY, Javid JANANI

Purpose: Subsidence has been associated with under sizing of the prosthesis, bone quality, and positioning of the implant in the disc space. This study looked at patients with Charite lumbar disc replacement and the incidence of subsidence in relation to the above factors.

Methods: Subsidence was defined as migration of the prosthesis more than 3 millimeters into the endplate. Post-op x-rays from a single surgeon's practice of 51 patients who underwent lumbar disc replacement between June 2000 and October 2005 were reviewed. Data taken into consideration included age, sex, tobacco use, positioning of the prosthesis inside the disc space and size of prosthesis. Serial x-rays were reviewed to determine subsidence occurrence in the post-op. period. Included in the data was the sagittal position (AP x-ray) of the prosthesis as well as anterior vs. posterior placement (lateral x-ray). X-rays reviewed 3 weeks, 6 weeks, 3 months, 6 months and yearly after surgery.

Results: The sample included 30 males (59%) and 21 females (41 %). Age ranged from 27 to 63 years. The average age was 39 years. Seven of the fifty patients (13.7 %) developed subsidence. Subsidence occurred within the first six weeks following surgery. Subsidence occurred into the superior endplate in all but one patient. There was no subsidence after six weeks postoperatively. Two patients with osteoporosis had no subsidence. There was no significant correlation with prosthesis size, age or sex.

Conclusions: The incidence of subsidence was higher in females but not statistically significant. Sagittal alignment of the prosthesis (more than 7 millimeters off center) correlates significantly with subsidence. The rate of subsidence in lumbar disc replacement does not have any statistical correlation with prosthesis size, age, sex, bone quality or anterior vs. posterior placement of the prosthesis.

MULTILEVEL TOTAL LUMBAR DISC REPLACEMENT FOR SYMPTOMATIC DISC DISEASE

Omer KARATOPRAK, Ufuk TALU, Mehmet AYDOGAN, Mehmet Nuri ERDEM, Azmi HAMZA OGLU

Introduction: Total disc replacement (TDR) for multilevel degenerative disc disease (DDD) in the lumbar spine has recently become an alternative to fusion. The purpose of this retrospective study was to evaluate the clinical and radiological results in patients who underwent multilevel TDR for DDD in the lumbar spine.

Material and methods: 14 patients underwent proDisc TDR 32 levels for lumbar DDD 20 were female and 6 were male and the average age was 42.4 (39-51) years. Pre-operative dynamic radiographs, provocative discography+CT and BMD measurement were also routinely performed before surgery. TDR was performed at two levels in 11, three levels in 2 and four levels in one patient. Level of surgery was L2-L3 in 4, L3-L4 in 6, L4-L5 in 12 and LS-S1 in 10 patients. The average follow-up was 24.1 (12-32) months. VAS and Oswestry Disability Index (ODI) were used for clinical evaluation. All cases analyzed at follow-up for implant position, interface ingrowth, segmental angular motion, heterotopic ossification, fa-

cet joint degeneration and adjacent segment abnormalities.

Results: Results of clinical evaluation by ODI and VAS are given in the table. (Table)

Average preop disc height was 4.6 (4-6) mm and it was improved to 12.1 (11-13) postoperatively. Average preoperative flexion-extension angle was 2.2° (2°-4°) and it improved to 7.1° (6°-8°) postoperatively. We did not confront any complications like implant malposition, subsidence, loosening, implant failure and dislocation or heterotrophic ossification, facet joint degeneration and adjacent segment abnormalities.

Conclusion: Multilevel TDR seems to be safer and more effective than fusion in the surgical treatment of multilevel DDD. Advantages are preservation of motion, shorter hospital stay and lower complication rate. However studies with larger patient populations and much longer follow-up are needed to determine the rate of adjacent segment degeneration and preservation of motion.

	Preop	3.mo	6.mo	12.mo	Latest f-up
ODI (%)	58.1 (50.2-66.3)	29.0 (20.2-37.2)	20.3 (18.4-22.8)	20.1 (19.0-21.2)	19.3 (18.2-20.8)
VAS	7.5 (5.7-11.1)	1.7 (0.9-2.9)	1.4 (0.8-2.8)	1.3 (0.8-2.6)	1.1 (0.6-2.4)

ORAL PRESENTATION

**USING PERCEPTIONS OF PAIN SEVERITY IN A GENERAL POPULATION
TO NORMALIZE VAS PAIN REPORTS**

**Robert L. KANE, Boris BERSHADSKY, Todd ROCKWOOD, Khaled SALEH,
Nazir Cihangir ISLAM**

Introduction: Pain is frequently measured by using a Visual Analog Scale (VAS) for different purposes in medical practice including spine surgery. Several studies showed that this method is simple and useful in examining changes in pain level over short time intervals in the same subject. However it is not clear if these ratings are also useful in analyzing differences across subjects, This ambiguity influences the reliability of the results and interpretations of both the clinical outcomes and research studies, especially during the follow-up of a cohort and the comparison of different samples. The purpose of this study is to create a method for normalizing VAS pain reporting on a common metric in order to control for the variation between different populations due to the differences in perception or evaluation of pain.

Method: Stage 1: A list of 226 pains was gathered from a convenience sample of lay

persons on the street and patients waiting at medical and orthopedic clinics (n=313). Age ranged between 45 and 75. Stage 2: These pains were ranked by performing Q sort by level of severity by health professionals (n=75) and 19 pains with the most stable rankings were selected. Stage 3: These 19 pains were rated by a sample of community-dwelling adults (n=1622) and a method of VAS standardization based on six selected pains was developed.

Results: Individual variations in pain ratings were found to be independent of respondent's age and gender, but were correlated with having experienced the type of pain and self-reported health status. A new scoring method that takes these correlations into account is proposed.

Conclusion: It is possible to standardize VAS pain ratings to compare pain between different populations.

IMPLANT RELATED PAIN: ANOTHER CAUSE OF FAILED DEGENERATIVE LUMBAR SPINE SURGERY (FDLS)

Ahmet ALANAY, Arya Nick SHAMIE, Raj VYAS, Thomas SCIOSCIO,
Gannon RUDOLPH, Jeffery WANG

Background: The etiology of FDLS may include a wide array of conditions. There is a group of patients who have recurrence of back pain despite a solid fusion in the absence of any obvious pain generator. Implant removal in those patients is a controversial optional treatment.

Purpose: To evaluate the efficacy and safety of implant removal, to determine the possible predictors of its efficacy.

Methods: 25 patients (10 M, 15 F) with an average age of 44 (18-74) were retrospectively evaluated. All patients had prior titanium posterior pedicle screw instrumentation and fusion for lumbar degenerative disorders. 20 patients with increase in pain during palpation of the operative side underwent a pre-operative anesthetic injection at the site of their trigger points.

Patients' clinical charts, operative notes and preoperative x-rays were evaluated. Relief of pain was evaluated by the percent VAS pain change due to implant removal. Functional improvement was rated on a five-point scale. Predictors of pain relief were analysed by using both bivariate and multivariate regression analysis. A p value ($p < 0.05$) was considered significant

Results: Average follow-up period was 20 (12-38) months. The median time after the index operation and the recurrence of pain was 13.5 (1-119) months. VAS decrease after implant removal was 50 %.

Conclusions: Removal of the implant is an efficient and safe procedure for carefully selected patients and most consistent predictor of its efficacy is the percent pain relief after the diagnostic injection of the painful operative side.

ORAL PRESENTATION

IS THE WALLIS IMPLANT CAPABLE OF REDUCING THE INCIDENCE OF RECURRENT LUMBAR DISC HERNIATION?

Yizhar FLOMAN, MA MILLGRAM, N. RAND, Y. SMORGICK, E ASHKENAZI

Summary: Recurrent disc herniation following a successful lumbar discectomy may necessitate repeat surgical intervention. A population based study in Finland found that about 14 % of all primary lumbar discectomies necessitated additional surgery.

Interspinous devices may perhaps help in reduction of the number of recurrent herniations.

Methods: 37 consecutive patients (23 males, 14 females, average age 36 years) underwent lumbar disc excision followed by fixation with the Wallis implant during a period of one year.

Indications for implanting the Wallis device following discectomy were a voluminous disc herniation and a relatively preserved disc space height.

Surgery was performed at the L4-5 space in most patients. Average follow-up after surgery was 12 months.

Results: Five patients with relapsing leg pain were diagnosed with contrast enhanced

MRI to suffer from ipsilateral recurrent herniation (13 % or 5/37). The disc reherniation occurred between 1-9 months after the index surgery.

The degenerative process leads to destabilization of the spinal motion segment, disc excision may further destabilize the spine. Hence there may be a need to normalize the motion segment following discectomy.

The Wallis implant seemed therefore a logical solution to the problem of recurrent herniation. The fact that 5 out of 37 patients experienced recurrent disc herniation despite the dynamic stabilization is certainly disappointing. Although the implant reduces intradiscal pressure, it is possible that the main problem leading to failure of the device was the annular defect.

Conclusion: The current implant is incapable of reducing the incidence of recurrent herniation.

**FORCED LORDOSIS ON THE THORACOLUMBAR JUNCTION CORRECT
DOUBLE CURVED CORONAL PLANE DEFORMITY AN INNOVATIVE
APPROACH ON ADOLESCENT IDIOPATHIC SCOLIOSIS WITH
CONSEQUENCES FOR TREATMENT AND DISCUSSION ON ETIOLOGY**

**Piet JM Van LOON, Robert KUHAUCH, Federik BMT THUNNISSEN,
Iob LC can SUSANTE, Corne IM Van LOON**

Background: AIS presents mostly with right thoracic and left thoracolumbar curves. Most commonly a double curve. Etiology is supposed to be multifactorial, but a lordotic component at the apex is said to be essential. Traditionally, conservative and surgical treatment focus on correction of the deformity by derotating and flexing counter force at the apex of the scoliosis. In this radiographic study we demonstrate that forced lordosis on the thoracolumbar junction, in a pure sagittal plane, can also lead to significant momentary correction of curves.

Methods: Coronal spine radiographs of 37 consecutive patients (32 female, 5 male, mean age 14.6 year) with a double curve (minimal 25 °) idiopathic scoliosis were obtained while standing, lying supine, and lying supine

with the thoracolumbar junction over a radiolucent lordotic fulcrum. Scoliotic Cobb angles were determined and evaluated for statistical significance.

Results: There was an expected correction of both the thoracic and the lumbar curve.

Conclusions: Own clinical experience forwarded that forced lordosis on the thoracolumbar junction can correct a scoliotic deformity of the spine. This insight may have clear consequences on the current philosophy of (bracing) therapies. This innovative approach may then also elucidate etiological factors involved in the development of deformities in explaining why the lordotic force transform the shortening effort of the spinal canal which is seen in progressive scoliosis to a supposed lengthening of the spinal canal.

ORAL PRESENTATION

DESIGN AND CLINICAL STUDY OF SHAPE MEMORY ALLOY SCOLIOSIS CORRECTION SYSTEM

Yan WANG, Yan WANG, Xuesong ZHANG, Zheng WANG

Introduction: Shape memory effect and super elastic capability of Ni-Ti alloy have been utilized for scoliosis correction. But its mechanical nature is influenced by the material element ratio, metallurgy techniques, and heat treatment procedure. No one described shape memory rods or super elastic rods combined with pedicle screws in correction of scoliosis patients before. But it is found by us that the rod can be easily installed into the pedicle screws along the abnormal spine in lower temperature, and whole instrumentation automatic resume to original set physiological figure together when warmed up, which can achieve three dimensions correction effect better and safely.

Methods: The shape memory alloy scoliosis correction system (SMAS) constituted of shape memory Ni-Ti alloy rod or super elastic Ni-Ti alloy rod and pedicle screws. Based on material study, relational mechanical and toxicity research, from Feb 1998 to Jan 2004, 23 cases of adolescent idiopathic scoliosis patients were treated by SMAS. Among them 10

cases adopted shape memory Ni-Ti alloy rod, and 13 cases adopted super elastic Ni-Ti alloy rod. Patients were evaluated before surgery, immediate after surgery, and at least 1-year follow-up according to radiographic changes in curve correction and maintains.

Results: There is no obvious complication during perioperation in these patients, no instruments broken was found. All cases finished 1-6 years following up, and achieved well balance. Preoperative original curve of average Cobb 65.8° were corrected to average 17.6° in coronal, correction rate was 73.2% immediate after surgery, and no obvious correction lost was found. From CT scan, apex vertebra rotation in cross section was corrected from average 35.3° to 21.2°, correction rate was 39.3 %.

Conclusions: Based on shape memory and super elastic nature, SMAS can achieve supposed correction effect safely and effectively, no biocompatibility problem was found.

THE EVALUATION OF SHOULDER BALANCE IN HEALTHY ADOLESCENT POPULATION AND ITS CORRELATION WITH RADIOLOGICAL MEASURES

Ibrahim AKEL, Murat PELMEZCI, Muharrem YAZICI, Mutlu HAYRAN, Orhan DERMAN, İlkay ERDOGAN, Ahmet ALANAY, Ozgur KOCAK

Introduction: In healthy individuals shoulders are accepted as level, but this general acceptance has not been confirmed before. The aim of this study is to evaluate the shoulder balance in normal population and to determine the ideal radiological method that reflects clinical shoulder balance.

Methods: Adolescents without orthopedic pathology formed the study group. They were asked to fill out a questionnaire assessing shoulder perception, and had their digital picture taken simultaneously with a P-A chest X-ray during which they were asked to stand straight and have their arms on sides. The clinical shoulder balance was evaluated by measuring the digital pictures with a special software. The X-rays were used to evaluate the radiological shoulder balance. The evaluated parameters were T1-tilt, clavicular angle (CA), coracoid height difference (CHO) and clavicular tilt angle difference (CTAD) and the difference between clavicular rib cage intersection points differences (CRID).

Results: The study group was composed of 71 patients. All stated that their shoulders were level. The clinical shoulder balance demonstrated level shoulders in only 11(% 16). Radiological examination showed level shoulders in 9 patients with CTAD, 8 with CA, 6 with CHD and 36 with CRID. T1-tilt was zero in 23 patients. The average CTAD was 3.9 ± 3.4 degrees (0-20), CA was 2.3 ± 1.8 degrees (0-11), CHD was 7.3 ± 5.1 mm(0-27.5), T1-Tilt was 1.4 ± 1.4 (0-6) and CRID 1.7 ± 2.1 (0 -7.6). The evaluation of the pictures revealed an average 7.7 ± 5.9 mm (0-27) height difference between shoulders. All radiological parameters but CRID correlated with clinical picture.

Discussion: In contrast to common belief, the shoulders are not level in healthy adolescents. Clavicular angle and coracoid height difference can be used reliably to evaluate clinical shoulder balance. Although CTAD demonstrated moderate correlation, it is still a valuable alternative when the shoulders are not completely seen on the X ray.

ORAL PRESENTATION

LATE REVISION SURGERY IN ADOLESCENT IDIOPATHIC SCOLIOSIS

Cuneyt MIRZANLI, Ufuk TALU, Mehmet TEZER, Cagatay OZTURK, Azmi HAMZAOGLU

Introduction: Revision surgery may be defined as a continuing or new-on set problem in a previously operated spine. Our purpose in this study was to determine and analyze the reasons or problems leading to revision surgery in adolescent idiopathic scoliosis (AIS) patients and discuss the possible methods or approaches for solution.

Materials and Methods: 25 AIS patients who had revision surgery between the years of 1994 and 2001 and had minimum two-year follow-up were evaluated. The average age was 13.4 (10-18) years. Reasons leading to revision surgery were pseudoarthrosis in 4, coronal plane decompensation in 2, sagittal plane decompensation (too short fusion) in 2, complex frontal and sagittal plane deformity (due to pseudoarthrosis) in 7, rib-hump in 2, implant failure (anterior instrumentation proximal screw pull-out) in 1, deep infection (not responsive to debridement and irrigation) in 3, late implant related reaction in 2, neural impingement by implant devices in 2 patients.

Results: Posterior fusion with compression instrumentation was performed for simple pse-

udoarthrosis patients. Posterior osteotomy or vertebrectomy or combined surgery was performed for patients who had complex frontal and sagittal plane deformity due to pseudoarthrosis. Stainless steel posterior implants were replaced by larger titanium pedicle screws in two patients and by titanium anterior instrumentation in one patient with deep infection. Implants were removed and revised in neural impingement cases. Fusion was extended proximally in cases with sagittal plane decompensation. The fusion was achieved in all patients, and neither pseudoarthrosis nor implant failure was observed.

Conclusion: Revision surgery for spinal deformity is extremely challenging and decision making requires considerable experience and expertise in complex reconstructive spinal surgery. Reasons for poor outcome after initial surgery and resulting in revision are poor patient selection, wrong initial diagnosis, wrong or inadequate surgical procedure, technical errors or complications.

COMPARISON OF COMBINED ANTERIOR AND POSTERIOR SURGERY WITH POSTERIOR ALONE SURGERY IN THE TREATMENT OF ADOLESCENT IDIOPATHIC SCOLIOSIS WITH THORACIC CURVES MORE THAN 70 DEGREES

Ufuk AYDINLI, Recep VURAL, Muren MUTLUER, Cagatay OZTURK

Introduction: The purpose of this study is to compare the radiological outcome of two surgical treatments: anterior-posterior spinal fusion versus posterior spinal fusion alone in patients with thoracic AIS curves more than 70°.

Materials and Methods: Twenty-one patients with adolescent idiopathic scoliosis thoracic curves more than 70° underwent surgical treatment between 1995 and 2003.

Results: The mean age of patients was 16.3 years (range, 11-19 years), with 17 females and 4 males. Mean follow-up was 5.4 years (range, 2-10 years). There were 11 patients in combined surgery group (group I) in which anterior release and fusion, posterior correction with instrumentation and fusion was performed. There were 10 patients in the posterior alone surgery group (group II) in which posterior correction and instrumentation and fusion was performed. The average Cobb measures (anteroposterior/lateral) are 90°/68° for

group I and 86°/66° for group II which was statistically insignificant. The traction flexibility was 27 % for group I and 37 % for group II ($p>0.05$). As concerning the sagittal curve, the results were similar (25 % versus 23 %, $p>0.05$). At the last follow-up, there was no difference in sagittal and coronal alignment change between the two groups (between 2-5 %). In addition, there were no statistically significant differences seen between the groups for gender and age.

Discussion: The surgical treatment of adolescent idiopathic scoliosis with curves more than 70 degrees by either combined anterior and posterior or posterior alone route showed the similar postoperative radiological results. We believe that posterior alone surgery is enough to provide same amount of correction with combined surgery and it prevents the adverse effects of combined surgery on pulmonary function.

ORAL PRESENTATION

INTRAOPERATIVE HALO-FEMORAL TRACTION IN THE TREATMENT OF SEVERE SCOLIOSIS (>100°)

Ufuk TALU, M. AYDOGAN, O. KARATOPRAK, Cagatay OZTURK, Mehmet TEZER, Azmi HAMZAOGLU

Introduction: Treatment of severe and rigid scoliosis is demanding despite modern instrumentation methods providing powerful correction. To our knowledge there is no report on using intraoperative halo-femoral traction in this patient population. The purpose of this study is to report on results of surgical correction achieved by intraoperative halo-femoral traction and posterior only pedicle screw instrumentation.

Method: 13 patients with severe (>100°) thoracic idiopathic scoliosis were studied. Average age was 17.5 (17-20) years. Major thoracic curve, major compensatory lumbar curve and sagittal curve were 125° (105°-156°), 58° (33°-69°) and 98° (45°-135°) respectively. Only one patient had more than 2 cm coronal decompensation but all had significant shoulder imbalance with average 11° (5°-15°) clavicle angle. Average preop. vital capacity was 2.67 l. All patients underwent intraoperatively halo-femoral traction and posterior pedicle screw instrumentation after wide facet resection and posterior release. Convex side thoracoplasty was also performed. Halo-femoral traction started with 12 kg (6 kg on the head, 3 kg on each leg) and gradually incre-

ased not exceeding 30-50 % of total body weight. Cervical instability and intramedullary abnormalities were ruled out.

Results: Average follow-up was 37 (30-44) months. Postoperative major thoracic curve, major compensatory lumbar curve and sagittal curve were 63° (39°-91°) (51 %), 55° (35°-85°) (62 %) and 49° (20°-80°) (49 %) respectively. All but one patient had good coronal balance. Shoulders were balanced in all patients with average 1° (0°-5°) clavicle angle. Average vital capacity improvement was 29 % (3.44). There was no correction loss, infection, pseudoarthrosis or complications related to halo-femoral traction.

Conclusion: Halo-femoral traction along with wide facet resection and posterior release gradually provide a good correction and balance maintained by pedicle screw instrumentation. No further corrective force needs to be applied by the instrument. Neuromonitoring or wake-up test can be performed during gradual correction before instrumentation. Complications of perioperative halo-gravity traction and/or anterior release are avoided.

CORPECTOMY RECONSTRUCTION OF VERTEBRAL BODY TUMORS USING AN EXPANDABLE TITANIUM CAGE FROM A POSTERIOR-ONLY EXTRACAVITARY APPROACH

Francis SHEN, Vincent ARLET, Simon BHATTACHARJEE, Mark HARPER, Ian MARKS, Jean OUELLET, Christopher SHAFFREY

Introduction: Surgical management of vertebral body tumors requires anterior decompression and reconstruction with or without a posterior instrumented fusion. Studies evaluating the role of extracavitary vertebral body resection and reconstruction with an expandable cage from a single posterior approach are limited.

Methods: Retrospective study 14 patients. A decompression was performed from a posterior extracavitary approach and reconstructed with an expandable cage. No patient required a separate anterior procedure. Stabilization was performed with a posterior spinal fusion and segmental screw fixation through the same exposure.

Purpose: To evaluate the feasibility of anterior spinal column reconstruction using an expandable cage through a single posterior extracavitary approach.

Results: Average age 58.9 years. Nine females, 5 males. Diagnoses 5 lung, 4 renal, 1 each breast, prostate, hepatocellular, ABC, and plasmacytoma. Thirteen 1-level (9 thoracic,

4 lumbar); one 2-level corpectomy (T12-L1). Average 4.9 levels fused. Average EBL and length of surgery per level was 1481 cc (range, 500 to 2500) and 5.3 hrs (range, 4.5 to 8.6 hrs). No mortalities associated with index procedure. Average stay 5.0 days. Of the 13 ambulatory preoperatively, all were ambulating on average by day 3.3 postoperatively. One patient had a decrease in neurologic strength, but remained ambulatory; 5 had an improvement. No chest tubes or bracing required. At average 13.5 months follow-up, 4 patients are alive. Ten patients expired an average of 5.6 months after surgery. No deaths were secondary to the surgery. One cage required repositioning and one cage settled, but did not require surgery; there were no other complications.

Conclusions: Our 15.4 % complication rate is similar to those reported in anterior alone and circumferential procedures. The use of an expandable cage combined with an extracavitary approach is feasible and allows the surgeon to address both the anterior and posterior columns through a single incision.

ORAL PRESENTATION

**SURGICAL RESECTION OF ANEURYSMAL BONE CYST (ABC)
OF THE SPINE**

Hossam SALAH, Youssry Kamal El HAWARY

It is estimated that 11 - 24% of aneurysmal bone cysts localize in the spine. Local recurrence following surgical treatment has been reported to range between 20-70 % in different series. We report our experience in the surgical management of these lesions of the spine. There were 12 patients; 7 males and 5 females. Age at time of surgery ranged between 4 and 18 years. All patients presented with axial pain, and 7 (58 %) with radicular pain. Four (33 %) patients had a neurological deficit, four (33 %) presented with spinal deformity and three (25 %) had a palpable mass. Nine (75 %) patients had previous surgeries (a total of 17 operations).

Complete intralesional surgical resection was performed in all patients. No adjuvant therapy was performed in this series. Resection required sequential anterior and posterior surgery in 9 patients and posterior surgery only in

three. Spinal reconstruction and stabilization was performed with a variety of methods depending upon the location of the lesion, its extent within the spine and the age of the patient.

Follow up period ranged 28 - 63 months. All patients reported improvement in their axial and radicular pain, three (75%) of those with a preoperative neurological deficit showed neurological recovery and one patient remained unchanged. At their latest follow-up, all patients showed evidence of radiological fusion, with no local recurrence detected.

In conclusion, total intralesional resection of ABC lesions of the spine is successful in managing these of tenly aggressive lesions. This series demonstrates the success of surgery in eradicating these lesions when thorough and complete resection is performed.

TREATMENT OF WOUND INFECTIONS FOLLOWING SPINAL FUSION AND INSTRUMENTATION USING CLOSED SUCTION IRRIGATION SYSTEM (CSIS): IS IMPLANT REMOVAL NECESSARY?

Michael T. ROHMILLER, Kian RAISZADEH, Kamshad RAISZADEH, Sarah K. CANALE, Behrooz A. AKBARNIA

Purpose: Wound infections following spine surgery can produce devastating consequences and are further complicated by the use of implants. Despite the need for a simple, yet reliable solution, none exists to date. This study describes the success rate of closed suction irrigation system (CSIS) in the treatment of spinal infections with instrumentation.

Methods: A retrospective record review identified 500 posterior instrumented fusions performed between 1990 and 2002. Twenty-eight infections (5%) were diagnosed and treated by a standardized treatment protocol. Diagnoses were: Idiopathic scoliosis (7), Fracture (7), Pseudarthrosis (4), Neuromuscular scoliosis (3), Stenosis/Degenerative spondylolisthesis (3), Myelomeningocele (2), Ankylosing Spondylitis (2). All patients were treated with I&D and CSIS placement. Cultures were obtained, all wounds closed primarily, and appropriate intravenous antibiotic treatments initiated. The treatment protocol dictated the appropriate time to discontinue drains.

For statistical evaluation, all patients were assigned a risk factor (RF) described by Levi, et

al. Point values were assigned to medical comorbidities that may contribute to post-operative infection risk; higher RF values indicate an increased risk.

Results: Twenty acute and 8 late (> 6 months) post-operative infections were followed a minimum 24 months post-CSIS treatment. Twenty-two (79%) resolved without recurrence with one CSIS treatment, including all late infections. Six acute infections (30%) required a second course of treatment. Hospitalization averaged 12.9 days; 14.8 days for reinfections. No patient with acute infection required implant removal.

The reinfection group had a higher RF value (0.85) than the single treatment group (0.63). The reinfection group also had higher blood loss, more levels fused, and longer hospitalization following the index procedure.

Conclusion: Patients with higher RF values are at greater risk for reinfection. Removal of implants is unnecessary in acute infections. CSIS is an effective method for treatment of postoperative wound infections following instrumented spinal fusion.

ORAL PRESENTATION

ANTERIOR INSTRUMENTATION SYSTEMS IN THE SURGICAL TREATMENT OF TUBERCULOSIS SPONDYLITIS. IS IT AN EFFECTIVE AND SAFE TECHNIQUE?

I. Teoman BENLI, Alper KAYA

Anterior instrumentation in active tuberculosis infection is a relatively new concept, and the results of this study should probably be compared to those achieved with other modalities of surgical treatment as well as other reports on anterior instrumentation. This study reports on the surgical results of 100 patients with Pott's disease that had anterior radical debridement and anterior fusion and anterior instrumentation with minimum 3 years follow-up. Average age at the time of operation was 44.3 ± 12.5 years. The indication for surgery was either one of the deformity, instability or neurological compromise. Surgical treatment included anterior radical debridement followed by grafting with tricortical autograft and anterior instrumentation at levels just above and below the diseased segment(s) with either plate or rod systems. The deformity in the sagittal and the coronal plane was measured and presence of significant consolidation, along with

the absence of implant failure or correction loss was considered as signs of fusion. Pre-operatively and at the last follow-up visit, the SRS-22 questionnaire was administered to the patients. Overall, it was observed that, the addition of anterior instrumentation increased the rate of correction of the kyphotic deformity (88.4 ± 21.5 %), and was effective in maintaining it with an average loss of 1.6 ± 1.8 . Of the 44 (44 %) patients with neurological symptoms, 40 (90.9 %) had full and 4 (9.1 %) partial recoveries. There were no apparent pseudoarthrosis and implant failures in the patients and all patients demonstrated clinical improvement in tuberculosis infection without recurrences and reactivation. The statistically significant improvement was found in all domains at the last follow-up visit ($p < 0.01$). It was concluded that anterior instrumentation is an effective and safe method in the treatment of tuberculosis spondylitis.

COMPARISON OF PAIN INTENSITY AND KYPHOSIS BETWEEN TWO-SEGMENT COMBINED INSTRUMENTATION AND FUSION VS. THREE-SEGMENT POSTERIOR INSTRUMENTATION AND FUSION IN THORACOLUMBAR BURST FRACTURES (RCT)

Nazir Cihangir ISLAM, Necdet SAGLAM, Ozkan KOSE, Yuvuz UCAR, Kurtulus EMREM

Introduction: The purpose of this randomized clinical trial is comparing the severity of residual kyphotic deformity and back pain between groups treated by "anterior and posterior combined instrumentation and fusion of two motion-segment" and "posterior only instrumentation and fusion of three motion-segments" in thoracolumbar burst fractures.

Methods: Neurologically intact thoracolumbar burst fractures (T12-L2) that carries the risk of kyphotic deformity (>20 / >50 % anterior wedging) were included regardless the degree of canal narrowing. Groups were randomized as two-segment posterior and anterior combined instrumentation and fusion (n=13) vs. three-segment posterior instrumentation and fusion (n=8), via adding one upper level to the fusion site posteriorly. Posterior pedicle screws were used for all cases. Anterior cages and anterior screws were applied to the combined group for anterior stabilization.

After nineteen-month follow-up (12-29 months) "duration of surgery, intraoperative blood loss, kyphosis angle, VAS, Oswestry and Roland-Morris questionnaires" were studied.

Results: Duration of surgery was significantly higher in combined fusion group (373 min) compared to posterior fusion group (288 min).

Conclusion: In thoracolumbar burst fractures, stability and integrity of spinal column could be restored and maintained by posterior instrumentation and fusion of three-motion segment or combined instrumentation and fusion of two-motion segment. Perception of back pain in polytraumatized patients with thoracolumbar burst fractures could be lower when compared to isolated thoracolumbar burst fractures which might become a confounder in research studies.

ORAL PRESENTATION

ANTERIOR AND POSTERIOR COLUMN RECONSTRUCTION BY SUBTOTAL VERTEBRECTOMY VIA POSTERIOR ONLY APPROACH IN OSTEOPOROTIC FRACTURES OF THE SPINE CAUSING NEUROLOGIC INJURY

Mehmet AYDOGAN, Ufuk TALU, Cuneyt MIRZANLI, Mehmet TEZER, Azmi HAMZAOGLU

Introduction: Vertebrectomy and instrumentation via posterior approach can be especially useful in elderly patients with severe osteoporotic fractures causing neurological injury. Those patients usually have significant medical problems and may not tolerate anterior surgery. The purpose of this retrospective study was to evaluate the posterior only subtotal vertebrectomy procedure in a group of patients who were older than 70 and had either thoracic or thoracolumbar osteoporotic fractures as neurological deficit.

Method: 14 patients with an average age of 74.7 (70-84) years have undergone vertebrectomy and posterior instrumentation via posterior approach only. Fractures level was between T1-10 in 8 and between T11-L2 in 6 patients. Those patients with thoracic fractures had severe spinal cord compromise and spastic paraparesis and pain unresponsive to medication. 3 of these 8 patients had previous kyphoplasty. Cement and bone fragments caused spinal cord compromise. All patients underwent pedicle screw fixation two level above

and below augmented with vertebroplasty. Hemilaminectomy and costatransversectomy were performed at lesion level to facilitate subtotal vertebrectomy and placement of titanium mesh cage for interbody fusion. Contralateral posterior elements were preserved for fusion.

Results: Average follow-up was 3.5 (2-5) years. Neurologic recovery was achieved in all patients was complete by 1.4 (1-3) weeks. An average VAS was 8.0 and 2.1 pre or postop respectively. We did not confront any implant related complications or infections. One patient developed a spontaneous fracture at lower adjacent segment which was treated by brace.

Conclusion: Surgical treatment via posterior approach only is helpful to lower the rate of mortality and morbidity in this patient population. Thus, it is possible to perform vertebrectomy, anterior fusion and posterior instrumentation via posterior approach only. We believe this approach provides definitive and effective treatment with minimal morbidity.

RECURRENT FRACTURE AFTER VERTEBRAL KYPHOPLASTY

William LAVELLE, Robert CHENEY, Joseph BELLAPIANTA

Background: Osteoporotic compression fractures cause great morbidity to the aging population. Various percutaneous methods have been developed to aid in treatment, including vertebral kyphoplasty. Biomechanical studies and recent published data relate concerns about adjacent fracture.

Purpose: This study investigated the incidence of recurrent fracture after the kyphoplasty procedure.

Study Design/Setting: Retrospective review of kyphoplasty procedures performed by a single surgeon.

Patient Sample: One hundred and nine procedures in 94 patients were reviewed.

Methods: Patient medical records as well as the radiology database at two major regional hospitals were reviewed for fracture recurrence.

Results: Confounding factors of age at procedure, sex, and chronic steroid use were also considered and found to have no statisti-

cally significant difference between those with fracture recurrence and those without fracture recurrence ($p=0.1979$, $p=0.2058$, $p=0.4684$ respectively). Eleven kyphoplasty procedures resulted in a recurrent fracture after kyphoplasty within the first 90 days (34 ± 19). After the first ninety days, five recurrent fractures occurred (459 ± 01). The number of vertebral levels treated was found to be related to incidence of recurrent fracture with a p-value of 0.0005 via chi-squared testing. Patients who sustained a recurrent fracture tended to have a higher number of vertebral levels treated. There was no statistically significant difference between the survival time of kyphoplasty procedures that resulted in recurrent adjacent versus distant vertebral body fracture (survival time 112 ± 145 vs 237 ± 268 , p-value 0.2362).

Conclusions: The incidence of recurrent fracture after kyphoplasty is substantial at 10 % within the first 90 days. It is difficult to determine if this fracture rate is due to surgical intervention or the natural history of the patient's osteoporosis.

ORAL PRESENTATION

EFFICACY OF EARLY SURGICAL DECOMPRESSION IN EXPERIMENTAL SPINAL CORD INJURY MODEL

Zekeriya OZTEMUR, Gunduz TEZEREN, Ishan BAGCIVAN, Bulent SARAC, Ahmet PARLAK, Reyhan EGILMEZ

Purpose: Evaluate the efficacy of early surgical decompression of acute spinal cord injury in experimental animal model by analysis of the corpus cavernosum and the bladder.

Methods: Twenty-one New Zealand rabbits were divided to four groups which were control group (6 animals), sham (laminectomy) group (5 animals), 15 seconds compression group (5 animals) and 60 seconds compression group (5 animals). Sixty gram compression force was applied to both 15 seconds and 60 seconds compression groups by an aneurysm clip. After 7 days, invitro relaxation and contraction tests of dissected corpus cavernosum of the animals and contraction tests of the bladder were performed in organ baths using carbachol.

Results: Maximum relaxation response of the corpus cavernosum with carbachol was similar between 15 seconds compression group

and 60 seconds compression group. Maximum relaxation response of the corpus cavernosum with carbachol decreased in 15 seconds and 60 seconds compression groups compared with control and sham groups. pO₂ values were similar in four groups. Maximum contraction response of the detrusor muscle in increasing carbachol concentrations was similar between 15 seconds compression group and 60 seconds compression group. Contraction response of the detrusor muscle with carbachol increased in either compression groups compared with control and sham groups. pO₂ values were similar in four groups.

Conclusion: There was no difference between early (15 seconds) and late (60 seconds) decompression in terms of the efficacy of early decompression according to maximum contraction and relaxation effects of the corpus cavernosum and the bladder.

STOPPING AT L3 INSTEAD OF L4 IN LENKE TYPE 6C OR KING TYPE I AND LV ALS -DO TRACTION RADIOGRAPHS UNDER GENERAL ANESTHESIA HAVE A ROLE?

Mehmet AYDOGAN, Omer KARATOPRAK, Mehmet TEZER, Cuneyt MIRZANLI,
Ufuk TALU, Azmi HAMZAOGLU

Introduction: The purpose of this study was to analyze preop radiographs for determining radiological criteria to stop fusion at L3 instead of L4 especially in Lenke 6C or King type I and IV curves, even when central vertical sacral line (CSVL) did not touch L3.

Method: This study involves 16 surgically treated AIS patients who had Lenke type 6C or King type I and IV curves. Average age was 15.6 (13-19) years. Distal fusion stopped at L3 in all patients. Preoperatively, standing AP and lateral, supine bending, supine traction and traction under general anesthesia (TrUGA) radiographs were obtained. Radiography measurements included Cobb angles, L3 and L4 tilt and rotation, determination of whether CSVL touched L3 or not and also positions of L3, L4 and LS with reference to Harrington's stable zone.

Results: Follow-up was 38° (30°-60°) months. Pre and post-op thoracic curves were 48° (30°-60°) and 10° (4°-17°) respectively.

Correction was 67 % (53 %-90 %). Pre and postop TL/L curves were 51° (40°-64°) and 8° (4°-14°) respectively. Correction was 83 % (70 %-91 %). Other radiologic data is summarized in the table (Table). CSVL did not touch L3 in any patient at preop standing AP however did so or bisect L3 at traction and TrUGA. At least 50 % of L3 vertebral body was entering Harrington's stable zone upon traction. L3 was level to pelvis in all patients postoperatively. None of the patients developed decompensation or correction loss during follow-up.

Conclusion: CSVL did not touch L3 in any of the patients at standing AP and L3 did not become level at bending radiographs in the majority. Traction was helpful in these cases because L3 became level, CSVL touched or bisected L3 and L3 was completely in Harrington's stable zone. Thus, choosing between L3 and L4 can be difficult but evaluation of preop traction and TrUGA radiographs and pedicle screws enable us stop fusion at L3.

	Pre-op	Traction	TrUGA	Bending	Post-op
L3 Tilt	25°(21°-30°)	8°(4°-14°)	5°(0°-9°)	2°(-7,+10°)	2°(0°-4°)
L4 Tilt	21°(17°-24°)	8°(3°-15°)	5°(0°-10°)	5°(0°-13°)	2°(0°-4°)
L3 Rotation	1-3	0-2	0-1	0-2	0-1
L4 Rotation	0-2	0-1	0-1	0-2	0-1

ORAL PRESENTATION

CAN WE PERFORM POSTERIOR FUSION AND STOP AT THE SAME DISTAL LEVEL AS WITH ANTERIOR SURGERY IN THE TREATMENT OF MAJOR THORACOLUMBAR AND LUMBAR (LENKE TYPE 5C) CURVES?

Omer KARATOPRAK, Mehmet AYDOGAN, Cuneyt MIRZANLI, Mehmet TEZER,
Ufuk TALU, Azmi HAMZAOGLU

Introduction: Choosing between L3 and L4 can sometimes be difficult and anterior surgery is recommended for Lenke Type 5C curves to save more motion segments distally. We analyzed if we can perform posterior surgery for Lenke Type 5C curves and stop fusion at the same distal levels as with anterior surgery .

Method: This study involves 14 surgically treated AIS patients who had Lenke type 5C curves. Posterior surgery and segmental pedicle screws were used to stop at the same distal fusion level as if anterior surgery was performed. Average age was 14.3 (12-15) years.

Results: Average follow-up was 32 (28-60) months. Pre and post-op minor thoracic curves were 17° (10°-30°) and 2° (0°-5°) respectively. Correction was 91 % (75 %-100 %). Pre and postop TL/L curves were 46° (38°-52°) and 5° (0°-14°) respectively. Correction was 88 % (65 %-100 %). Other radiologic data is summarized in the table.

CSVL did not touch L3 in any patient at pre-op standing AP however did so or bisect L3 at traction and TrUGA. Average 40 % of L3 vertebral body was in Harrington's stable zone at preop AP. However L3, L4 and L5 vertebral bodies were within Harrington's stable zone upon traction. Minor thoracic curve was fused in 4 patients to avoid shoulder asymmetry.

Conduision: Supine bending radiographs are generally helpful to see if L3 is mobile and becomes level with pelvis to stop fusion. However sometimes there is too much residual L3 rotation at bending radiographs which may cause hesitation for stopping at L3. We have noted that traction radiography, especially when taken under general anesthesia shows better correction of rotation at L3 and encourages stopping fusion at that level. Thus it is possible to perform posterior surgery, save motion segments distally and avoid morbidities related to anterior surgery.

	Pre-op	Traction	TrUGA	Bending	Post-up
L3 Tilt	22°(16°-27°)	7°(3°-12°)	5°(0°-7°)	0°(-10°, +5°)	2°(0°-6°)
L4 Tilt	18°(15°-23°)	8°(3°-12°)	5°(0°-7°)	1.4°(-6°, +7°)	5°(0°-8°)
L3 Rotation	0-3	0-2	0-1	0-3	0-1
L4 Rotation	0-3	0-2	0-1	0-3	0-1

