



MEASUREMENT OF SAGITTAL INCLINATION OF THE LUMBAR VERTEBRAE AT PRONE POSITION

A. Esat KITER⁽¹⁾, Fahir DEMIRKAN⁽¹⁾, B. Alper KILIÇ⁽¹⁾, Gürkan ERKULA⁽¹⁾, Ertan ER⁽¹⁾

Institution(s)

⁽¹⁾ Pamukkale University School of Medicine Department of Orthopedics; Pamukkale Üniversitesi Tıp Fakültesi Hastanesi Ortopedi ve Travmatoloji Anabilim Dalı

Objective: Transpedicular screws are widely used in spinal instrumentation, however many complications could be seen during this procedure. Anatomical landmarks, entry points and proper screw inclination in transverse and sagittal planes are important points during transpedicular screw application. Besides the orientation of pedicle in sagittal plane, motions of the vertebra in sagittal plane may have an effect on direction and position of screw. In this study, sagittal inclination of lumbar vertebra in prone position is investigated.

Methods: Right lateral decubitus position (DP) and prone position (PP) radiographs are obtained from 30 volunteers (average age 29 years old) without low back complaint. The position of the patient during the radiographs is similar to the prone position during surgery which is routinely used in our clinic. Longitudinal pillows with a diameter of 18 cm are placed under the chest and abdomen extending from axilla to the iliac crest. Sagittal plan inclination (SPI) of each vertebra are measured manually on both radi-

ographs. Values are analyzed statistically with paired t test.

Results: SPI of the L1 vertebra at DP and PP position are measured as +19.8 and 14.3 respectively ($p=0.000$). SPI of the L2 vertebra are measured as +16.0 at DP position and +13.1 at PP position ($p=0.017$). There are no statistically significant difference between groups of L3, L4 and L5 level (respectively $p=0.973$, $p=0.056$ and $p=0.071$). There is statistically significant difference in lumbar lordosis between two groups ($p=0.000$).

Discussion: Lumbar vertebrae have greater range of motion at sagittal plane. According to our results upper lumbar vertebrae (L1-L2) have significant movement when the patient's position DP is changed to PP. During the application of transpedicular screw fixation at upper lumbar vertebrae (L1-L2) radiological evaluation of the sagittal alignment of the upper lumbar segments at prone position may contribute to the proper insertion of the screw.

THE USE OF DEMINERALIZED BONE MATRIX WITH AUTOGENOUS BONE GRAFT, OR ALLOGENIC BONE GRAFT FOR POSTEROLATERAL LUMBAR INTERTRANSVERSE SPINE FUSION

Şevki KABAK^{(1)(B)}, Volkan KAYAR^{(1)(O)}, Mehmet HALICI^{(1)(O)}, Mahmut ARGUN^{(1)(O)},
Sami ENGIN^{(1)(O)}

Institution(s)

1) Orthopaedics and Traumatology Department; erciyes University, Medical Faculty, 38039
Kayseri/Turkey

The aim of this study designed as an experimental model of posterolateral intertransvers fusion in rabbits is to demonstrate effectiveness of combination of demineralized bone matrix with autogenous or allogenic bone grafts on bone formation and spinal fusion in the cases autogenous bone graft is insufficient or not possible.

In this study, single-level lumbar arthrodesis was performed at L5-L6 in 110 adult New Zealand White rabbits. The rabbits were divided into 5 groups. The rabbits were assigned to one groups based on the graft material they received: 3.0 mL demineralized bone matrix (DBM; made from rabbit bone) (Group I), 1.5 mL DBM plus 1.5 mL allogenic bone graft (Group II), 1.5 mL DBM plus 1.5 mL autogenous bone graft (Group III), 3 mL autogenous bone graft (Group IV), and 3 mL allogenic bone graft (Group V) on each side. Rabbits were killed after 6 and 12 weeks, and the spines were excised and evaluated by manual palpation, radiographs, biomechanical testing and histology.

Fusions were assessed by manual palpation at 6 weeks for comparisons among the five groups of graft materials. The DBM used with allogenic bone graft resulted in fusion 60% (6/10), when combined with an equal amount of autogenous iliac crest bone, DBM resulted in fusion 80% (8/10). At the 12 weeks, the DBM combined with allograft resulted in fusion 80% (8/10) whereas that combined with autogenous graft resulted in fusion 100% (10/10). The groups II and III were of statistically significant superiority to the remaining groups with regard to mean stiffness and ultimate load to failure. There was no statistically difference between the group II and III in this regard. More mature fusions with greater amounts of trabecular bone were present histologically in rabbits that received DBM than those which autograft and allograft were used.

In cases for which an adequate quantity of autogenous bone grafts is not available, combination of DBM with allogenic or autogenous graft may facilitate greater bone formation and successful fusion.

EXPERIMENTAL SPINAL FUSION WITH BIOABSORBABLE RODS

Murat BEZER^{(1)(B)}

Institutions(s)

¹⁾Marmara University Hospital Department of Orthopaedics and Traumatology; Marmara Universitesi Tip Fakultesi Hastanesi Tophaneliođlu Caddesi No: 13/15 81190 Altunizade-Istanbul

Purpose of Study: To examine the potential benefits SR-poly lactide rods in posterior spinal fusion.

Methods: Twenty-four skeletally immature rabbits were divided into three groups. Bioabsorbable rods were fixed in eight immature rabbits onto three adjacent laminae on the right side. In the stainless steel instrumentation group 2,5 mm rods were used similarly. In control group eight rabbits were used. The adjacent three laminae of these rabbits were decorticated but not instrumented. Autogenous bone grafts were placed on the laminae to obtain fusion. The imp-

lantation area was assessed for bone formation and fusion by radiography and histological examination.

Results: There was a significant difference between bone formation in the instrumented two groups and the control group individually. When the stainless steel and SR-poly lactide instrumentation groups were compared, no significant difference was noted.

Conclusion: The SR-poly lactide rod was found to be an effective metallic rod substitute for achieving in situ posterior spinal fusion.

COMPARISON OF SHORT SEGMENT PEDICLE INSTRUMENTATION WITH SUPPLEMENTAL HOOK FIXATION (UNDER AXIAL COMPRESSION): A BIOMECHANICAL STUDY ON CALF SPINE

Kıvanç MURATLI⁽¹⁾⁽⁰⁾, Haluk BERK^{(1)(B)}

Institution(s)

¹⁾ Dokuz Eylül University; DEU, School of Medicine, Department of Orthopedics and Traumatology, 35340 İzmir, Turkey

Objectives: The aim of this study is to determine the added benefits of supplemental hook fixation to standard short segment pedicle instrumentation construct by means of screw and rod strain measurements.

Background: Implant failure is an important and a common problem in cases with unstable burst fractures treated with standard short segment pedicle instrumentation. Several methods can be utilized to prevent this including supplemental sublaminar offset hook fixation, anterior strut grafting and use of longer spinal constructs.

Study Design: In this biomechanical study stresses in screw necks and rod strains were measured comparing short segment pedicle screw fixation and supplemental hook fixation (Argenson method) under axial compression. The role of anterior grafting technique and effect of posterior ligamentous structures were also evaluated.

Materials and Method: Four calf spines were instrumented with standard short segment pedicle screw-rod fixation method and four other calf spines instrumented with supplemental sublaminar offset hooks on cranial and caudal ends of the instrumentation. Strain gauges were placed on the neck of all four pedicle screws and on

the rods. Measurements done for each specimen in the following order; intact spine, corpectomy, strut grafting (graft placed anteriorly), strut grafting (graft placed more posteriorly), anterior strut grafting with negative posterior ligaments and and vertebrectomy with absent posterior ligaments. Six channel strain measurement was done for each specimen under axial compression in the order of 400, 500 and 600 Newtons.

Results: Statistical analysis of recorded data done using Mann Whitney U test. 108 parameters evaluated for each specimen and the results showed no statistically significant difference except for the 3rd experiment group (vertebrectomy + anterior strut graft) distal pedicle screw (screw number 3) strain measurements, 4th experiment group (vertebrectomy + posterior strut graft) distal pedicle screw measurement (screw number 3) and 5th experiment group (vertebrectomy + anterior strut graft + (-) posterior ligaments) distal pedicle strain measurements (screw number 3). These ones showed significantly higher strain measurements in the short segment group.

Conclusion: It can be assumed that under axial compression, supplemental hook fixation with Argenson method only brings some limited benefits.

IN VITRO BIOMECHANICAL EVALUATION OF A NEW ROD-SCREW IMPLANT SYSTEM FOR THE POSTERIOR OCCIPITO-CERVICAL INSTRUMENTATION

Balkan ÇAKIR^{(1)(B)}, H-J WILKE^{(2)(O)}, L. CLAES^{(2)(O)}, W. PUHL^{(1)(O)}, M. RICHTER^{(1)(O)}

Institution(s)

¹⁾ Department of Orthopaedics and SCI; University of Ulm, Germany

²⁾ Department of Orthopaedic Research and Biomechanics; University of Ulm, Germany

Introduction: Posterior instrumentation of the occipito-cervical spine is established in different indications. The use of rod-screw systems improved posterior instrumentation due to optimal screw position adapted to the individual anatomic situation. However there are still some drawbacks concerning the different implant designs. Therefore a new modular rod-screw implant system was developed to overcome some of the drawbacks of established systems. The aim of this study was to evaluate whether posterior internal fixation of the occipito-cervical spine with the new implant system improves primary biomechanical stability.

Methods: Three different internal fixation systems were compared in this study: 1. Cervi-Fix system 2. Olerud cervical rod spinal system 3. Newly developed Neon occipito cervical system. Eight human cervical spine CO-C5 specimens were instrumented from CO to C4 with occipital fixation, transarticular screws in C1/2 and lateral mass or pedicle screws in C3 and

C4. The specimens were tested in flexion/extension, axial rotation, and lateral bending using pure moments of :1:2.5 Nm without axial preload. After testing the intact spine the different instrumentations were tested after destabilising CO/C2 and C3/C4.

Results: Primary stability was significantly increased in all load cases with the new modular implant system compared to the other implant systems. Pedicle screw instrumentation tended to be more stable compared to lateral mass screws, nevertheless significant differences could be observed only for lateral bending. As the experimental design precluded any cyclic testing the data represent only the primary stability of the implants.

Conclusions: In summary this study showed that posterior instrumentation of the cervical spine using the new Neon occipitocervical system improves primary biomechanical stability compared to the Cervi Fix system and the Olerud cervical rod spinal system.

Preliminary Results for Axial Low Back Pain Treated with Coblation: A Comparison of Patients with and without a Central Focal Protrusion

Curtis W. SLIPMAN^{(1)(B)}, Atul L. BHAT^{(1)(O)}, Russell V. GILCHRIST^{(1)(O)}, Zacharia ISAAC^{(1)(O)}, Anthony LEE^{(1)(O)}, Cyndi GARVAN^{(1)(O)}, Larry CHOU^{(1)(O)}, David A. LENROW^{(1)(O)}, Edward 1. VRESILOVIC JR^{(1)(O)}

Institution(s)

1) Hospital of the University of Pennsylvania; Penn Spine Center Research Group

Objective: It is widely accepted that the most common etiology of low back pain is that of discogenic disease. A new minimally invasive technology of Coblation or Nucleoplasty may provide a less aggressive alternative treatment of a proven symptomatic contained disc protrusion. The objective of this study was to report on our preliminary results for axial low back pain treated with Coblation.

Methods: A prospective study design using an independent reviewer to assess consecutive patients with back pain greater than leg pain was used. Other inclusion criteria included absence of precipitating trauma, symptom duration of at least 6 months, absence of a neurological deficit, and failure to respond to conservative management including the use of oral or injected analgesics/anti-inflammatory agents combined with physical therapy. Results of lumbar magnetic resonance imaging (MRI) led to categorization of subjects into two groups. Patients with a central focal protrusion (CFP) deemed to "tent" the posterior longitudinal ligament constituted Group I and those without a central focal protrusion were identified as Group II. Following a provocative discography reproducing concordant pain, coblation was subsequently performed at the affected level using a power level set of two. Outcome measures used included visual analog scores (VAS) score and modified Oswestry disability score. Each patient was assessed immediately prior to the intervention and at 2 weeks, 1 month, 2 months, 3 months, and 6 months. Statistical analysis was performed using a student-t test.

Results: There were fourteen patients who met the inclusion criteria (Group I: 7; Group II: 7). A total of 9 disc levels received Coblation in each group. For Group I, the disc levels were L3-4 (n=1), L4-5 (n=4), and L5-S1 (n=4). For Group II, the disc levels were L2-3 (n=1), L4-5 (n=2), and L5-S1 (n=6). Of Group I, five of seven patients demonstrated a statistically and clinically significant improvement in each of their outcome measures. In contrast, only one of seven from Gro-

up II demonstrated clinical improvement. For the five patients from Group I that improved the average and range of VAS ratings were: Pre-49 (25-70); 2 weeks-21 (5-40); 1 month-24 (5-50); 2 months-17 (5-30); 3 months-17 (5-30), 6 months-17 (5-30). At each follow-up time interval there was a statistically significant difference ($p < 0.05$) for VAS and Oswestry disability scores when compared with to the baseline scores. For patients in Group II, there was no statistical significant difference in any of these ratings.

Discussion and Conclusion: Coblation technology generates RF energy that is applied to a conductive medium, creating a highly focused plasma field around the introduced catheter. The plasma field comprised of highly ionized particles leads to cleavage of organic molecular bonds within the applied tissue; in this instance nucleus pulposus. The end result is the low temperature, molecular disintegration of nuclear material resulting in a controlled volume of tissue removal, while simultaneously avoiding collateral annular or end plate necrosis. Microscopic studies have documented the presence of a large continuous network of interlacing nerve fibers innervating the posterior longitudinal ligament. Their afferent pathway is primarily through the sinuvertebral nerve into either the rami communicantes or ventral rami of the respective segmental disc level. The presence of such neural input suggests that a tensile force applied to the posterior longitudinal ligament may lead to the perception of back pain. If this concept were accurate then one would expect symptom reduction to rapidly transpire when that load is removed. In this study, reducing the volume of nuclear material appears to have effectively reduced this tensile load. This pilot study suggests that coblation may be a useful technique in the treatment of patients with back pain secondary to a central herniated nucleus pulposus associated with "tenting" of PLL and not in patients without such a central herniated nucleus pulposus.

DISC TEMPERATURE MEASUREMENTS DURING NUCLEOPLASTY AND IDET PROCEDURES

Duran N. YETKINLER^{(1)(B)}, William H. NAU^{(2)(O)}, Lari L. BRANDT^{(1)(O)},
Chris DIEDERICH^{(2)(O)}

Institution(s)

¹⁾ ArthroCare; 680 Vaqueros Avenue, Sunnyvale, CA 94085 U.S.A.

²⁾ UCSF Comprehensive Cancer Center; Department of Radiation, 1600 Divisadero St, Suite H1031 San Francisco, CA 94143-1708 U.S.A

Objective: Minimally invasive devices for the treatment of contained herniated discs are gaining popularity. The Nucleoplasty procedure both ablates and coagulates the nucleus pulposus to provide disc decompression, while IDET provides heat at the nuclear-annular junction. Temperature assessments in and around the intervertebral disc tissue are important to understand the safety and efficacy of the devices.

Methods: Three temperature experiments were conducted. First, radial temperatures were obtained in fresh chicken breast tissue during the ablation phase of the Nucleoplasty (ArthroCare Corp., Sunnyvale, CA) procedure. Using power setting 2 for 5 seconds, temperatures were recorded using thermocouple probes, every 0.1 seconds.

In the second experiment, the Nucleoplasty procedure was performed using an array of custom multi-junction thermocouple probes (5 to 6, 0.5 mm diameter junctions 2 or 5mm spacing) placed throughout a human cadaveric specimen. Transient temperature data was collected at 26+ points within the desired heating volume.

The last experiment compared the temperatures achieved at key anatomical locations during the IDET™ (Oratec Interventions, Inc., Menlo Park, CA) and the Nucleoplasty procedures in a human cadaveric lumbar spine model. Two fresh frozen human cadaveric spine specimens

were obtained and L 1-L2 through L5-S1 intervertebral discs were used in both specimens. In both procedures, temperatures were recorded as temperature increase from baseline.

Results: For the radial temperature distributions, after 5 seconds of heating in ablation mode, the maximum temperature change at the tip was 19.7°C and measured 0.5°C mm at radial distance of 4mm.

Intradiscal temperatures of 60-65 °C in the cadaveric spine were obtained within 2-3 mm radial distance from the introducer path, using the Nucleoplasty procedure.

For Nucleoplasty, the average temperature increase (TI) in the cadaveric nucleus and superior endplate was 6.0°C and 1.8°C, respectively. In the IDET procedures however, the average TI in the nucleus and superior endplate were 13°C and 12.4°C, respectively. Essentially no TI occurred at the nerve root in either the Nucleoplasty or IDET procedures.

Discussion and Conclusions: These preliminary results suggest that the Nucleoplasty procedure results in relatively lower temperatures, providing a somewhat higher margin of safety than other procedures, such as the IDET procedure. Temperature distributions and intradiscal temperatures in cadaveric models further support the safety of the practice.

THE EFFECT OF RADIOFREQUENCY ENERGY ON DURAL TISSUE: HISTOMORPHOLOGIC ANALYSIS

Michael VIVES^{(1)(B)}, Richard MANOS^{(3)(O)}, Philip YUAN^{(2)(O)},
Christopher KAUFFMAN^{(2)(O)}, Steven GARFIN^{(2)(O)}, Duran N. YETKINLER^{(4)(O)}

Institution(s)

¹⁾ North Jersey Orthopaedic Institute; Department of Orthopaedics, 90 Bergen St.-DOC Suite 1200,
North New Jersey, NJ 07103 U.S.A

³⁾ University of San Diego; Department of Orthopedics, 200 West Arbor Drive, San Diego, CA 92103
U.S.A

²⁾ Navy Medical Center; 34800 Bob Wilson Drive, San Diego, CA 92134 U.S.A

⁴⁾ ArthroCare; 680 Vaqueros Avenue, Sunnyvale, CA 94085 U.S.A.

Objective: Radiofrequency energy is an innovative technology offering promise for applications including soft tissue ablation, disc removal and scar tissue dissection in spinal surgery. Bipolar RF devices have been shown to cause minimal collateral tissue damage, however the effects of radiofrequency energy on dural tissue is unknown. The objectives of our study were to analyze collateral tissue in dural tissue exposed to radiofrequency energy.

Methods: Fresh frozen cadavers underwent laminectomy from T4 to L1. The bipolar radiofrequency electrode was placed in direct contact with the dura and used at settings "5" and "9" for 1 and 3 seconds, until dural penetration occurred. Epithelial destruction and collateral tissue damage were measured in histologically prepared tissue by scanning electron microscopy.

Results: Macroscopically, dura tissue shrank at the point where the device was activated, for all power settings and time duration. His-

tologic analysis revealed minimal tissue alteration in the superficial dura mater in specimens in which the device was activated for one second. Lesions measured 300-400 microns deep x 1-1.5 millimeter wide. Specimens treated for 3 seconds, showed lesion sizes of 1.75-2.0 millimeter wide x 700-800 microns deep. Dural penetration occurred after activating the device for 5 seconds. The dura surrounding the treatment level was markedly thickened and the fibro-collagenous matrix compacted and moderately homogenous. The subdural connective tissue, dorsolateral fasciculus and nerve roots, immediately below treatment pathway appeared unaffected in all specimens.

Discussion and Conclusions: Radiofrequency energy has potential to become an adjunct in both minimally invasive and open spine surgery. Our results, in cadaveric tissue, suggest that collateral damage to the dura and underlying neural structures is minimal unless a transmural dural defect is created.

THE OUTCOME OF SURGERY OF ACUTE VERTEBRAL FRACTURES OF THE THORACIC AND LUMBAR SPINE

JJ. VERLAAN^{(1)(B)}, C.H. DIEKERHOF^{(1)(O)}, F.C. ONER^{(1)(O)}, WJ.A. DHERT^{(1)(O)}, A.J. VERBOUT^{(1)(O)}

Institution(s)

¹⁾ *University Medical Center Utrecht; Heidelberglaan 100, 3584 CX; Utrecht, The Netherlands*

Study Design: A systematic review was performed on the available literature for the outcome of surgical treatment of acute traumatic vertebral fractures of the thoracic and lumbar spine.

Objectives: To provide information on the safety and outcome of the various surgical approaches in terms of radiological deformity, neurological status, functional recovery and complications.

Summary of Background Data: Different techniques of operative treatment of spinal fractures have been introduced and used extensively during the last two decades. General performance of these techniques, results and complications have not been studied from literature since 1994.

Methods: A MEDLINE search was performed to obtain the relevant publications ($n \geq 10$ and follow-up ≥ 12 months) describing the surgical treatment and outcome at follow-up. All data were extracted uniformly using pre-defined criteria. The data were regrouped in five subgroups: posterior short-segment (PS), posterior long-segment (PL), combined reports of posterior short and long segment (PSL), anterior (A) and anterior combined with posterior, either long or short (AP).

Results: From 376 papers resulting from the search, 240 were rejected due to failure to meet the inclusion criteria or insufficient data. The remaining 136 papers describe the treatment and results of a total of 5463 patients. The sample size of each subgroup was PS: 1825; PL: 1839; PSL: 903; A: 628 and AP: 268. Patient characteristics: The mean age for each subgroup were comparable (range: 32-35 years) and the mean follow-up varied between 25 (AP) and 37 months (A). Most of the fractures, 60 % (PL) to 84% (A), were 'burst' type fractures. The neurological deficits varied for the subgroups. The mean local kyphosis angle at admission ranged from 13.1 (PSL) to 23.7 (A)

degrees.

Surgical Details: Mean blood loss varied from 912 ml (PS) to 1584 ml (AP) while mean duration of the intervention ranged from 190 min. (PS) to 450 min. (AP).

Radiological outcome: The mean local kyphosis angle directly post-operative and at final follow-up was, PS: 0.2 and 6.3; PL: 5.6 and 11.8; PSL: 0.5 and 5.3; A: 7.9 and 11.3 and for AP: 2.4 and 11.9 degrees.

Neurological outcome: Only two patients, both from PL, deteriorated neurologically (Frankel E to D) following surgery. A deficit, if present, improved 1 or 2 Frankel scales in 55 % (PL) to 78 % (A) of the patients.

Functional outcome: During follow-up pain was reported not to be a problem in 65 % (PSL) to 89 % (A), while 54 % (PSL) to 83 % (PS) were re-employed in their former jobs.

Complications: Post-operative complications were relatively rare but included deep infections of the surgical site (mean 1.7% of all patients), mal-positioning of devices (mean 3% of all patients) and early device failure (2.5% of all patients) without obvious differences between the subgroups. Late complications were device failure (3.3% (AP) to 18.4% (PSL)) and non-elective reoperations (3.6% (PS) to 8.7% (PL)) although these late events seemed to have remarkably little impact on the clinical results.

Conclusions: Despite significantly different techniques, operative treatment of thoracic and lumbar spine fractures, in general, seems to be a safe and effective treatment option. Complication rates, even during the introduction period of operative treatment, are low. Functional outcome, i.e. pain and employment, seems to be better than generally believed.

RESULTS OF CONSERVATIVE TREATMENT IN THORACOLUMBAR VERTEBRAL FRACTURES

Erden ERTÜNER^{(1)(B)}, Mehmet TEZER^{(0)(O)}, İrfan ÖZTÜRK^{(1)(O)}, Ünal KUZGUN^{(1)(O)}

Institution(s)

¹⁾ Şişli Etfal Training and Research Hospital. and 2. Orthopaedics and Traumatology Clinics;
Şişli / Istanbul

Introduction: Treatment modalities for thoracolumbar vertebral fractures differ according to the type and stability of the fracture and neurological deficiencies present. Stable fractures are generally treated conservatively whereas a surgery is planned for the unstable ones.

Materials and methods: Out of 227 conservatively treated patients in the period of 1988-1999, 48 cases with adequate follow-up period were included in our study. Average age of patients (23 female, 25 male) is 46.2 with a range of 18-76 years. Follow-up period varied between 31 to 137 months with an average of 77.5 months. Mechanism of injury was a fall from a height in 29 cases (%60.4), motor vehicle accident in 13 cases (%27.1), simple fall in 5 cases and direct trauma in 1 case. 32 compression fractures (%60.4) and 16 burst fractures (%33.4), both being mostly in the thoracolumbar junction, were detected. None of the patients presented neurological deficit. 29 cases were treated by TLSO (Thoracolumbosacral orthosis), 7 by body cast, 6 by bed rest only, and 6 by body cast followed by TLSO. In addition to pain and functional scoring, angle of kyphosis and scoliosis, wedging index, vertebral index and height loss percentages were measured and compared at the time of injury and in the follow-up periods.

Results: In compression fractures, the results were found to be statistically insignificant when angle of kyphosis, vertebral index and height loss percentages were compared ($p>0.05$). Differences in angle of scoliosis and wedging index were statistically significant ($p<0.05$). Pain score had an average value of 1.66 while functional score was found to be 1.03. In burst fractures, angle of kyphosis did not change statistically before and after treatment ($p>0.05$). Percentile values of angle of scoliosis, vertebral index, wedging index, and height loss were increased after treatment ($p<0.05$). Mean pain score was 1.26 and functional score was 0.93 in burst fractures.

Conclusion: In our study, deformity was increased after conservative treatment in plain radiography but pain and functional scores did not accompany this increase. We conclude that compression fractures with angle of kyphosis less than 30° can be accepted as stable and treated conservatively. If angle of kyphosis is more than 30°, MRI (Magnetic resonance imaging) should be obtained and if posterior ligamentous complex is damaged, surgery should be considered. In burst fractures, posterior ligamentous complex should be imaged by MRI and conservative treatment should be considered if there is no neurological deficit and the ligaments are intact. Otherwise, surgery should be planned.

VERTEBROPLASTY WITH THE USE OF HYDROXIAPATITE CYLINDRICAL STICKS IN TREATING PAINFUL THORACOLUMBAR OSTEOPOROTIC COLLAPSE

Tomoaki TOYONE^{(1)(B)}, Tadashi TANAKA^{(1)(O)}, Daisuke KATO^{(1)(O)}, Ryutaku KANEYAMA^{(1)(O)}

Institution(s)

¹⁾ *Kimitsu Chuo Hospital;1010 Sakurai, Kisarazu-city, Chiba, 292-8535 Japan*

Objective: The aim of this study was to determine the efficacy of vertebroplasty with the use of hydroxiapatite (HA) in treating painful thoracolumbar osteoporotic collapse.

Methods: Vertebroplasty with the use of HA was performed for 16 patients (11 women, five men; 61-80 years old) with osteoporotic vertebral collapse suffering from intractable pain that had been unrelieved by nonoperative care over a three-month period. Eight patients underwent this procedure percutaneously under local anesthesia. The other eight patients were treated by additional bisegmental posterior transpedicular instrumentation (Universal Spine System) under general anesthesia. Both groups were comparable with regard to age and degree of vertebral deformity. In order to augment the deficient bone, eight to ten HA cylindrical sticks (4x40mm, processed by solid HA granules) were inserted transpedicularly. External support was continued for six months.

Results: No patients were lost up to at least oneyear follow-up. Neither neurological compromise nor failure of the screw fixation was observed. Wedging rate was defined as a percentage of the anterior vertebral height to the posterior one. The mean wedging rate of all 16 cases was

43% (range, 20-66%) preoperatively and 90% immediately after operation. In patients without instrumentation, postoperative radiological examinations demonstrated progression of collapse, and the wedging rate was 50% at 12 months after surgery. In patients with instrumentation, the 1055 of correction within the fractured vertebral body was small, and was maintained up to the final follow-up.

Although surgery provided relief of pain in all cases, the correction loss was associated with back pain. All eight patients with instrumentation were satisfied with the outcome of their surgery, whereas only three out of eight patients without instrumentation were satisfied.

Discussion and Conclusion: Vertebroplasty with polymethylmethacrylate has become increasingly popular. Extrusion of polymethylmethacrylate into the spinal canal leading to neurological compromise, however, has been reported. In this study, collapsed vertebral bodies of patients with severe vertebral deformity were filled with HA cylindrical sticks. This procedure has been effective to relieve pain without any neurological complications, but additional posterior instrumentation is to be recommended.

THE COURSE OF NON-SURGICAL MANAGEMENT OF BURST FRACTURES WITH INTACT POSTERIOR LIGAMENOUS COMPLEX (PLC): AN MRI STUDY

Ahmet ALANAY^{(1)(C)}, Egemen TURHAN^{(1)(P)}, Emre ACAROGLU^{(1)(O)}, Muharrem YAZICI^{(1)(O)},
Aysenur CILA^{(1)(O)}, Adil SURAT^{(1)(O)}

Institution(s)

¹⁾ Hacettepe University Department of Orthopaedics and Traumatology; Ankara 06100 Turkey

Purpose: A prospective study to evaluate the results of nonsurgical treatment of burst fractures with intact PLC and to investigate the effect of trauma and/or residual kyphotic deformity on adjacent and neighboring (next-adjacent) discs.

Material and Methods: Fifteen consecutive neurologically intact patients with burst fractures (T11-L2) were managed nonoperatively with the indication based solely on the integrity of PLC determined by MRI. Correction of deformity and stabilization with a total body cast under sedation were the mainstays of treatment. Patients were mobilized the next day and casts were removed at the end of the 3rd month f/up with no further external stabilization. Local kyphosis (LK), sagittal index (SI) and percent of compression of body height (ABH) were measured on pre-treatment, post-treatment, 3rd month and latest f/up x-rays. All patients' preoperative and latest f/up MRI studies were analyzed to examine discs adjacent to and neighbouring the fractured levels. Patients' perception of function, pain and appearance were analysed using Likert Questionnaire.

Results: There were 8 female and 7 male patients with an average age of 28 (range 15-49) years. Average f/up was 31 (24-51) months. Twelve patients had Denis type B while 3 had type A fractures.

Pre-treatment MRI analysis revealed changes in the shape of the discs (narrowing or herniation into the body) with no change in the sig-

nal intensity of nucleus pulposus (NP) in 8 of the cranial and in 5 of the caudal adjacent discs. On follow-up MRI, there was only one intact disc with abnormal shape cranially. All others had height loss but only one had complete loss of signal intensity. Caudally, 4 additional discs had changes in shape without any gross changes in signal intensity of NP. None of the neighbouring discs had changes in shape or signal intensity at the time of injury or at latest f/up. Average score of function, pain and appearance were 4, 4 and 3.5 respectively at the latest f/up. All patients returned to original work at 3.6 (range 1-9) months on average and all were satisfied with their treatment.

Discussion: Conservative treatment based on integrity of PLC is controversial, probably due to poor evaluation by clinical and indirect radiographic findings. Degenerative changes in the adjacent discs due to trauma and/or residual kyphotic deformity is a common expectation. Our study revealed that an intact PLC may not prevent loss of correction gained by non-surgical management of burst fractures. Significant loss occurs in the first 3 months despite external stabilization. However, the magnitude of residual deformity usually remains close to the original deformity. Although changes in the shape of adjacent discs occur due to trauma and/or natural course, significant loss in signal intensity of nucleus pulposus is very unlikely. Patient outcome seems to be highly satisfactory despite residual deformity.

LUMBAR VERTEBRAL TRANSVERSE PROCESSES FRACTURES: ARE THEY REALLY INNOCENT?

Bülent DAĞLAR^{(1)(B)}, Bülent Adil TAŞBAŞ^{(1)(O)}, Kenan BAYRAKCI^{(1)(O)}, Güzelali OZDEMİR^{(1)(O)},
Uğur GÜNEL^{(1)(O)}

Institution(s)

1) Ankara Numune Training and Research Hospital; 4th Orthopaedic and Traumatology Clinic

Objective: to investigate the clinical importance of fracture of the lumbar vertebral transverse processes.

Methods: 106 patients, sustained different kinds of trauma between January 2000 and January 2001, were included in the study. All patients were operated for intra abdominal causes. Of these 62 (%58) had one or more fractured lumbar transverse processes documented (group I) and remaining 44 had not (group II). Age, gender, additional skeletal and intra abdominal injuries, ISSs, laboratory tests results at presentation, transfusion needs and the end results were compared using SPSS 10,0 package.

Results: Patients with transverse process fractures were older (38 versus 27, $p=0,001$,

$r=0,452$, $r^2=0,204$). Trauma causes, ISS, additional systemic traumas, skeletal traumas were not different between groups (p values are; 0,148, 0,125, 0,423, 0,673 respectively). However, hemoglobin levels, intra abdominal organ injuries, total hospital stay and end results were significantly different in group I ($p= 0,005$, 0,042, 0,002 and 0,012).

Discussion and conclusion: Although lumbar transverse process fractures do not directly related with vertebral stability, the presence of such a fracture should alert physicians. Especially in multiply injured patients, lumbar vertebra transverse process fracture predisposes more serious intra or retroperitoneal organ injuries.

COMPARISON OF THE RESULTS OF ANTERIOR SCREW-PLATE INSTRUMENTATION AND ANTERIOR DUAL-ROD SCREW INSTRUMENTATION IN THE TREATMENT OF THORACOLUMBAR BURST FRACTURES

Serdar AKALIN^{(1)(B)}, İ.Teoman BENLİ^{(1)(O)}, Gökhan TEMELLİ^{(1)(O)},
Mehmet ÇITAK^{(1)(O)}, Mahmut KIŞ^{(1)(O)}

Institution(s)

¹⁾ *Social Security Ankara Teaching Hospital- 1st Orthopaedics And Traumatology Department; Ankara*

The potential for clinical and neurological instability following thoracolumbar fractures has evoked a progressive increase in interest in the surgical treatment of unstable thoracolumbar fractures. Ninety-nine consecutive patients who had thoracolumbar burst fracture associated with neurological deficit, spinal canal compromise over 30%, sagittal index more than 15° were treated with single stage anterior spinal decompression, strut grafting and anterior spinal instrumentation at 1st Orthopaedics and Traumatology Clinic of Social Security Ankara Teaching Hospital. Mean follow up was 57 months. Mean correction rate in sagittal index was 75.6% in 54 patients in which anterior titanium plate-screw fixation system (Z-Plate) was used and 79.7% in patients treated with anterior dual-rod-screw fixation system (Cotrel Dubousset Hopf (CDH)). Statistically significant difference was not obtained ($p>0.05$) in these two patient

groups regarding sagittal index, however follow up and the last control data showed statistically significant difference in correction loss in the patients which plate-screw instrumentation was used. (mean Plate-screw instrumentation: $5.8^{\circ}\pm 2.4^{\circ}$, mean CDH $1.1^{\circ}\pm 1.4^{\circ}$). Also, any frontal plane deformity was not noted in patients with CDH instrumentation but averagely 7.1° of iatrogenic scoliosis was caused in 13.9% of the patients with plate-screw instrumentation. None of the patients had iatrogenic neurological deficit and 90.9% of the patients with neurological deficit improved at least one Frankel grade. In conclusion it is suggested that dual rod-screw fixation system (CDH) provided higher success in the treatment of thoracolumbar burst fractures at the restoration of frontal and the sagittal plane contours compared with anterior Z-plate screw system.

EVALUATION OF SPINAL CANAL COMPRESSION AND REMODELING AND THE EFFECT OF POSTERIOR INSTRUMENTATION AND FUSION IN THORACOLUMBAR BURST FRACTURES

Serdar AKALIN^{(1)(B)}, Özgür KARAKAŞ^{(1)(O)}, İ.Teoman BENLİ^{(1)(O)},
Evrin DUMAN^{(1)(O)}, Mahmut KIŞ^{(1)(O)}, Erbil AYDIN^{(1)(O)}

Institution(s)

1) Social Security Ankara Teaching Hospital - 1 st Orthopaedics And Traumatology Department;
Ankara

The disappointing results achieved with conservative treatment, the use of computed tomography and the developments in spinal biomechanics leading a better understanding of vertebral fractures have led to an increasing popularity of surgical treatment of thoracolumbar vertebral fractures in the last 15 years. From 1994 to 2000, 326 patients with thoracolumbar burst fractures were treated surgically at 1st Orthopaedics and Traumatology Clinic of Social Security Ankara Teaching Hospital. One hundred of these patients with a minimum follow up of 36 months were included in this study who admitted for the last control CT scans.

The aim of this study was to evaluate the spinal canal remodeling after posterior instrumentation and fusion.

Views that were obtained from the scanograms were processed by AutoCAD 2000 program regarding antero-posterior diameter, interpedicular diameter and the area of the spinal ca-

nal of the one above, one below and the affected segment(s) and the scales were measured and corrected. Mean age was 40 years of the sum of 40 female and 60 male patients.

The preoperative, postoperative and last control mean spinal canal area at the affected segment were 1.61 ± 0.44 cm², 1.81 ± 0.43 cm² and 2.21 ± 0.54 cm² and mean anteroposterior diameter were 1.03 ± 0.21 cm, 1.2 ± 0.34 cm, 1.33 ± 0.30 cm and mean interpedicular diameter were 2.22 ± 0.40 cm, 2.21 ± 0.38 cm and 2.39 ± 0.35 cm respectively.

The results showed statistically significant difference in anteroposterior diameter and spinal canal area suggesting effective remodeling of spinal canal after surgical treatment of thoracolumbar burst fractures with posterior instrumentation and fusion. Also this study is noted to be the first in the literature regarding the technique used to measure the scanograms and suggested to be effective and reliable.

EFFECT OF THE DIFFERENT INSTRUMENTATION TECHNIQUES IN PROTECTING THE SURGICAL CORRECTION OF THE UNSTABLE THORACOLUMBAR VERTEBRAL FRACTURES

Erhan SERİN^{(1)(B)}, Lokman KARAKURT^{(1)(O)}, Erhan YILMAZ^{(1)(O)}, Oktay BELHAN^{(1)(O)}

Institution(s)

¹⁾ *Firat University; Medical Faculty, Department of Orthopaedics and Traumatology, Elazığ, Turkey*

Objectives: The purpose of this study was to investigate the effect of the different instrumentation techniques in protecting the surgical correction of the unstable thoracolumbar vertebrae fractures.

Methods: 56 cases with unstable thoracolumbar vertebrae fractures were treated surgically and divided into 3 groups according to the instrumentation technique. Group I had 21 cases with offset-hook long segment posterior instrumentation, group II had 20 cases with long segment posterior instrumentation and group III had 15 cases with short segment instrumentation. Lateral radiogram of the thoracolumbar vertebrae at the early postoperative period and 12th month postoperatively was taken and wedge index (W_{early}, WI-12), local kyphosis angle (LCA-early, LCA-12), anterior compression angle (ACA-early, ACA-12) and compression ratio (CR-early, CR-12) were estimated in all groups

and statistical analysis was performed with student's t-test.

Results: Between the group I and group II, there was no difference statistically. Between the group I and group III, significant difference was found for WI-12, LCA-12, ACA-12, CR-early and CR-12 ($p < 0.05$). Between the group II and group III, there was significant difference for LCA-12, ACA-12, CR-early ($p < 0.05$). Group I and Group II had more stability than group III for protecting the intraoperative vertebral deformity correction along the postoperative period.

Discussion and conclusion: For protecting the surgical correction of the unstable vertebrae fractures, offset-hook long segment instrumentation and long segment instrumentation was superior to the short segment instrumentation. According to us, short segment instrumentation technique is a bad choice for unstable thoracolumbar vertebral fractures.

THE RESIDUAL ROTATION AND TILT OF THE LOWEST INSTRUMENTED LEVEL (LIV) IN POSTERIOR INSTRUMENTATION FOR ADOLESCENT IDIOPATHIC SCOLIOSIS (ALS) ARE THEY REALLY IMPORTANT?

Emre Acaroğlu^{(1)(C)}, Vedat Deviren^{(1)(O)}, Ahmet Alanay^{(1)(P)}, Akın Çil^{(1)(O)}, Akın Üzümcügil^{(1)(O)},
Muharrem Yazıcı^{(1)(O)}, Adil Surat^{(1)(O)}

Institution(s)

¹⁾Hacettepe University Department of Orthopaedics and Traumatology; Ankara 06100 Turkey

Purpose: Posterior instrumentation for AIS is usually extended down to the least rotated (neutral) because of the possibility of decompensation. This study aimed to clarify the relationship between the residual rotation and coronal plane tilt of the lowest instrumented level and the frontal, sagittal and transverse plane parameters of imbalance.

Patients and Methods: Forty-seven AIS patients (ave. age 14,5±1,9) treated with posterior translation instrumentation were included. Average f/up was 49,6±20,5 (24-96) months. PA and lat. X-rays obtained pre- and post-operatively and at latest f/up visits were measured for frontal and sagittal curve magnitudes, AP tilt and offset of T1, sag. offset of T1, rotation of the level below LIV and shoulder balance (coracoid process height). In thirty patients, additional rotation measurements of 10 landmark levels (inc. T1, interclavicular bisect (ICB), upper end of inst. (UIV), apices, LIV, level below LIV (LBLIV) and L4) were measured by CT pre- and post-operatively, at 6 and 12 months, and normalized by the rotation of pelvis.

Results: The thoracic curves measured 57,4 ± 13,6 deg pre-, 19,4 ± 9,4 deg post-operatively (66,4±13,6 % correction) and 22,2±11,9 deg at latest f/up. LIV was at T12 in 5, L1 in 11, L2 in

14, L3 in 14 and L4 in 3 cases. Rotation immediately below these levels as measured by the Pedriolle method was 8,8 ± 6,2 (0-25) deg pre-, 9,1 ± 6,4 (0-30) deg postoperatively (11,5 % increase) and 10,0±7,6 (0-30) deg at latest f/up, the corresponding coronal tilts were 15,5±8,0 deg, 5,4±4,3 deg, and 9,7±9,9 deg respectively. The magnitude of neither significantly affected the T1 tilt, AP and sag. T1 offset and shoulder balance. Likewise, the CT measurements of rotation revealed that residual rotation at the vicinity of LIV was not associated with a rotational imbalance (p>0,05)(Table 1).

Rotation (deg)	LBLIV	LIV	T1	ICB
Pre-op	9,2±6,2	10,4±7,5	5,6±4,4	4,3±4,2
Post-op	9,6±5,5	9,6±5,7	4,1±4,7	6,1±4,4
6 mos.	10,3±5,5	12,4±6,7	3,3±3,2	2,3±3,3
12 mos.	9,4±5,0	10,0±7,0	3,5±2,4	3,4±2,4

Conclusion: The residual angular deformity at the level of the lower end of posterior translation instrumentation for AIS could not be demonstrated to have any effect on the overall post-operative balance of the spinal column in any of the planes.

SCOLIOSIS SCREENING WITH EVALUATION OF JOINT LAXITY. THE RELATION BETWEEN TRUNK ROTATION AND JOINT LAXITY

A. Esat KITER^{(1)(C)}, Gurkan ERKULA^{(1)(O)}, B. Alper KILIÇ^{(1)(O)}, Ertan ER^{(1)(P)}

Institution(s)

1) Pamukkale University School of Medicine Department of Orthopaedics; Denizli Pamukkale Üniversitesi Tıp Fakültesi Hastanesi Ortopedi ve Travmatoloji Anabilim Dalı, Denizli

Objective: Adam's forward bending test and scoliometric measurements are preferred in school screening because of its low radiation and its cost effectiveness. However, real spinal deformity could not be evaluated with both techniques.

Many investigators have noted the association of the joint laxity and scoliosis. However the relationship between joint laxity and scoliosis is unclear. In the current study, the joint laxity of the children are also evaluated during scoliosis screening. The data obtained from screening, especially trunk rotation are analysed statistically to determine their relationship with joint laxity.

Methods: One thousand two hundred seventy three (598 females-675 males) primary school children with an average age of 10,4 (8-15), are recruited for the scoliosis screening. The trunk rotation is measured by forward bending and scoliometer, among the other spinal tests, and their joint laxities are evaluated by using Beighton scoring system. Trunk rotation of 7° and over are evaluated radiographically.

Results: Joint laxity is found in 41 children (3,2%), and trunk rotation of and over is found in 30 children (2,3%). Joint laxity in children with trunk rotation of 7° and over is found to be greater than those with 6° and less, but only a third of the children (n=10) is found to have a significant scoliotic curve after radiographic analysis.

Discussion: Although the number of the scoliotic patients are not enough for a definitive conclusion, there are some findings which denote a specific relation between scoliosis and joint laxity. Interestingly, children without a scoliotic curve, but a trunk rotation of over 7°, are found to have a higher incidence of joint laxity than the general population. The use of scoliometer determine the trunk rotation in the thoracic and lumbar region however there might be several other reasons that can change this topography of the surface other than scoliosis. This study shows that joint laxity may be one of the reasons changing the topography of the thoracic and lumbar region.

RELIABILITY OF THE SUPERFICIAL ABDOMINAL REFLEXES IN SPINAL EXAMINATION

A. Esat KITER^{(1)(C)}, Gurkan ERKULA^{(1)(O)}, Ertan ER^{(1)(P)}, Haluk BERK^{(2)(O)}

Institution(s)

¹⁾ *Department of Orthopaedics, Pamukkale University School of Medicine, Denizli, Turkey; Pamukkale Üniversitesi Araştırma Hastanesi, Doktorlar Caddesi, Denizli*

²⁾ *Department of Orthopaedics, Dokuz Eylül University School of Medicine, Izmir, Turkey; Dokuz Eylül Tıp Fakültesi Hast. İnciraltı-İzmir*

Objective: Examination of the superficial abdominal reflexes in scoliotic patients has been considered important in early detection of spinal cord pathology. The purpose of this study is to evaluate and discuss the importance of the superficial abdominal reflexes in the spinal examination.

Methods: Four hundred and eleven (189 girls- 222 boys) primary school students were screened. Average age of the children was 10,6 years (8-13). After full physical examination, spine was evaluated in Adams forward bending position with scoliometer. Testing of the reflexes is performed in four quadrants surrounding umbilicus.

Results: Three hundred seventy two (90.5%) subjects had bilaterally normal superficial abdominal reflexes. Twelve (2.9%) subjects had no reflex detected in at least one quadrant. Two (0.4%) subjects completely had no reflexes on the left side. Twenty-five (6%) children had absent reflex in all quadrants. Favorable reflexes examination could not be performed in nine-

teen (4.6%) subjects because of tickling sensation. There are no statistically significant differences between boys and girls, younger than 10-year-old group and older. There was no statistically significant correlation between the presence or absence of abdominal reflexes and scoliosis (n=5).

Discussion: Precise neural pathway of the superficial abdominal reflexes is not completely understood yet. It can be absent in healthy population. Different techniques of the abdominal reflex testing can affect the results. To eliminate abdominal muscle contraction, cooperation with the child is important. In the current study 4.6% of the subjects tested negative reflexes because of the muscle contraction due to inevitable tickling sensation. In our opinion, contribution of the superficial abdominal reflexes examination. In deciding further neurological examination or performing an MRI investigation is a poor indicator. If a surgery is planned one should perform precise neurological examination and obtain MRI of the scoliotic spine when in doubt.

CORRECTION OF ADOLESCENT IDIOPATHIC SCOLIOSIS USING THORACIC PEDICLE SCREW FIXATION VERSUS TRADITIONAL HOOK CONSTRUCTS: A SINGLE SURGEON RETROSPECTIVE REVIEW

**Steven K. STORER^{(1)(C)}, Michael G. VITALE^{(1)(P)}, Darria E. LONG^{(2)(O)}, Julie C. CHOE^{(2)(O)},
Joshua E. HYMAN^{(1)(O)}, Francis Y. LEE^{(1)(O)}, David P. ROYE Jr. ^{(1)(O)}**

Institution(s)

¹⁾ *Children's Hospital of New York; 3959 Broadway, 8th Floor, New York, New York 10032, USA*

²⁾ *International Center for Health Outcomes and Innovation Research; [Institution Address]*

Objective: There is considerable controversy regarding the role of pedicle screws in the correction of thoracic spinal deformity. While pedicle screws offer several theoretical advantages, including more rigid fixation, improved correction, and decreased loss of correction with time, these advantages have not been examined rigorously in all cases. Furthermore, many surgeons have voiced concern about the potential for higher rates of neurological complications with their use. The purpose of this study was to retrospectively review the senior author's surgical outcomes comparing traditional hook constructs and constructs including thoracic pedicle screws for the treatment of adolescent idiopathic scoliosis.

Methods: A retrospective review of 25 consecutive cases of children with adolescent idiopathic scoliosis undergoing instrumented posterior spinal fusion by the senior author was conducted. Immediate preoperative and 6-week postoperative radiographs were examined and the patients were categorized into two groups: (1) those in whom the construct involved thoracic pedicle screws and (2) those in whom the thoracic construct was composed solely of hooks. The endpoints of interest included radiographic measures, complications, and revision surgery. Quality of life outcomes were measured using the Child Health Questionnaire (CHO). Independent sample t-tests were used to determine whether there were any significant differences in these outcomes between the two patient groups.

Results: Among the 25 patients, 10 children underwent spinal fusion using thoracic pedicle screw fixation, and 15 children underwent thoracic

constructs composed solely of hooks. The majority of the patients were girls (20 girls vs. 5 boys). The average age of the patients at the time of surgery was 14.5 years and did not differ between the two patient groups. The mean preoperative Cobb angle of the structural curve was 53.5 degrees for the screw group and 52.5 degrees for the hook group. The mean percent correction was 70.2% for the screw group and 68.1 % for the hook group. There were no significant differences between the two patient groups in terms of percent change after surgery, absolute change after surgery, apical vertebral translation, or end vertebral tilt angle. There were no neurological complications in either group. There were no significant differences in quality of life outcomes between the two groups. The cost of constructs using thoracic pedicle screw fixation is significantly greater.

Discussion and conclusions: In the treatment of adolescent idiopathic scoliosis in this patient group, the correction obtained from thoracic pedicle screw fixation was comparable to traditional hook constructs. Our results represent the senior author's twenty-years of experience using segmental hook instrumentation and his initial experience using thoracic pedicle screw fixation. Both constructs are reliable in treating adolescent idiopathic scoliosis, with potential for excellent deformity correction and a high margin of safety. Because these constructs represent the senior author's early use of thoracic pedicle screw fixation, ongoing analysis may show improved correction with subsequent thoracic pedicle screw constructs.

PEDIATRIC SPINE DEFORMITY: ASSESSING PATIENT OUTCOMES AND QUALITY OF LIFE

Michael G. VITALE^{(1)(B)}, Douglas E. LEVY^{(2)(O)}, Julie C. CHOE^{(2)(O)}, Annetine C. GELIJNS^{(2)(O)}, Alan 1. MOSKOWITZ^{(2)(O)}, Joshua E. HYMAN^{(1)(O)}, Francis Y. LEE^{(1)(O)}, David P. ROYE Jr.^{(1)(O)}

Institution(s)

¹⁾ Children's Hospital of New York; 3959 Broadway, Bth Floor, New York, New York 10032, USA

²⁾ International Center for Health Outcomes and Innovation Research; 600 West 168th Street, 7th Floor, New York, New York, USA

Objective: The objective of this study was to assess the validity of several new pediatric outcomes instruments in measuring the quality of life in children with scoliosis.

Methods: Parents of 279 children seeking care for spinal deformity completed both the Child Health Questionnaire (CHQ) and the American Academy of Orthopaedic Surgeons (MOS) Pediatric Outcomes Data Collection Instrument (PODCI); the Scoliosis Research Society (SRS) instrument was completed directly by the affected children, as dictated by the developers of this measurement tool. The treating physician completed a subjective rating of physical and psychosocial health and documented pertinent socioclinical data for each child. Scores were compared with one another and to the clinical parameters using univariate statistics.

Results: Ceiling effects were noted for each instrument, particularly in the physical function and self esteem domains. However, patients with scoliosis scored significantly lower than previously published normative values for "healthy" children in several domains of the CHQ (t-

test): physical function ($p < 0.005$), role physical ($p = 0.02$), bodily pain ($p = 0.01$), parental time impact ($p = 0.02$), parental emotional impact ($p < 0.005$), behavioral scale ($p < 0.005$), and family cohesion ($p = 0.001$). Moreover, patients with larger curves exhibited larger detriments in health status as measured by the CHQ, supporting the face validity of this measure. In general, the CHQ exhibited superior psychometric characteristics over the MOS-PAI in this population. Four SRS domains were correlated with degree of curvature: physical function ($r = -0.17$, $p = 0.008$), bodily pain ($r = -0.32$, $p < 0.005$), self image ($r = -0.24$, $p < 0.005$), and satisfaction ($r = -0.29$, $p = 0.02$).

Discussion and conclusions: The CHQ, MOS PODCI, and SRS measure all suggest that scoliosis has a negative effect on the physical and psychosocial health status of affected adolescents. The CHQ may be the most practical to administer and offers several advantages. Further work is necessary to better define the appropriate use of these health status measures in this unique population.

EFFECT OF BRACING ON THE QUALITY OF LIFE OF ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

Obinwanne F. UGWONALI^{(1)(C)}, Guillem LOMAS^{(2)(O)}, Julie C. CHOE^{(2)(O)}, Joshua E. HYMAN^{(1)(O)},
Francis Y. LEE^{(1)(O)}, Michael G. VITALE^{(1)(P)}, David P. ROYE Jr. ^{(1)(O)}

Institution(s)

- 1) Children's Hospital of New York; 3959 Broadway, 8th Floor, New York, New York 10032, USA
- 2) International Center for Health Outcomes and Innovation Research; 600 West 168th Street, 7th Floor, New York, New York 10032, USA

Introduction: While available data suggest that bracing may improve the natural history of adolescent idiopathic scoliosis patients with moderate curves, little attention has been paid to the potential impact of brace treatment on the psychosocial health and quality of life of adolescent patients. The purpose of this study was therefore to assess quality of life issues, including self-image, role function, and psychosocial health, in a cohort of patients under evaluation for adolescent idiopathic scoliosis and to examine differences between patients treated with a brace versus patients treated with observation alone.

Methods: Quality of life data was collected from all patients with a diagnosis of adolescent idiopathic scoliosis and a spinal curvature greater than 10 degrees at the Children's Hospital of New York between September 1997 to June 2001. Two new quality of life instruments were used to capture physical and psychosocial aspects of quality of life -the Child Health Questionnaire (CHQ) and the American Academy of Orthopaedic Surgeons (MOS) Pediatric Outcomes Data Collection Instrument (PODCI). Parent responses to both questionnaires were used as proxies for their children. Regression and multivariate analyses were conducted to compare the two groups (brace versus observation group) and to determine the effect of age, gender, and Cobb angle on quality of life.

Results: Our patient cohort consisted of 130 patients, who were predominantly female (76%), with an average curve of 28 degrees and an average age of 13.6 years. Ninety patients were treated with observation alone (average curve 24

degrees), while 40 patients were treated with bracing (average curve 36 degrees). The quality of life in this group of adolescents with idiopathic scoliosis significantly differed from age-adjusted norms for three CHQ domains, all of which were higher in our patient group - behavior scale ($p=0.001$), self-esteem ($p=0.01$), and parental-impact time scale ($p=0.0003$). Furthermore, regression analysis showed differences in several quality of life domains within this group of adolescents. Overall, girls tended to have higher quality of life scores, especially with respect to general health ($p=0.0497$), parent-impact time scale ($p=0.03$), expectations ($p=0.042$), and upper extremity & physical function ($p=0.01$). In addition, as the Cobb angle increased, quality of life tended to be lower, particularly on the parental-impact emotion scale ($p=0.003$) and the physical summary score ($p=0.02$). There were few differences in health-related quality of life between patients undergoing brace treatment versus those undergoing observation. Multivariable analysis with Bonferroni adjustment showed that braced adolescents had statistically higher quality of life scores in only one CHQ domain (parental impact-time scale, $p=0.0498$) and one PODCI domain (happiness, $p=0.027$). The remaining domains were not statistically significantly different between the two treatment groups.

Discussion and conclusions: While adolescent idiopathic scoliosis may affect quality of life in this patient group, patients treated with spinal bracing did not seem to have significantly different health-related quality of life, as compared with patients in the observation group.

THE EFFECT OF APICAL VERTEBRAL INSTRUMENTATION IN SURGICAL TREATMENT OF KING TYPE II CURVES

Ömer AKÇALI^{(1)(B)}, Can KOŞAY^{(1)(O)}, Emin ALICI^{(1)(O)}

Institution(s)

¹⁾ Dokuz Eylul University, School of Medicine Dept of Orthopedics and Traumatology; Dokuz Eylul University, School of Medicine Dept of Orthopedics and Traumatology Balçova - IZMIR

Aim: The aim of this study is to evaluate the effect of apical vertebral instrumentation in the surgical treatment of King type III idiopathic scoliosis.

Materials and Method: Seventy-six consecutive patients with King type II idiopathic scoliosis, treated with posterior spinal instrumentation were included into the study. The mean age was 14.5 years (10-18), and the mean follow-up was 49 (28-74) months. Preoperative radiological evaluation was performed with posteroanterior, lateral, traction and side-bending radiograms. Vertebral rotation was measured with Perdriolle torsionmeter. Patients were retrospectively divided into two groups according to the presence of apical vertebra instrumentation. Group 1 consisted of 43 patients and both upper and lower neutral and intermediate vertebrae of thoracic curves were instrumented on concave side. In Group 2, there were 33 cases and instrumentation of apical vertebra on the concave

side was added to the configuration of Group 1. Posterior fusion was added in all patients. Thoracic and lumbar Cobb angles, sagittal plane measurements and axial plane measurements were compared between two groups both preoperatively and at the last follow-up.

Results: Preoperative age-gender distribution, Cobb angle and rotational measurements, and correction ratios on side-bending films were similar in both groups. Although, preoperative mean values of both thoracic and lumbar Cobb angles, sagittal plane measurements and apical rotation were not statistically significant between two groups ($p>0.05$), postoperatively, mean values of apical rotation were significantly different ($p<0.05$). At the same time, apical derotation ratios were significantly different between Group 1 and 2 ($p=0.000$).

Conclusion: We conclude that instrumentation of apical vertebra provides better derotation at the apex of the King type II curves.

ASSESSMENT OF CURVE FLEXIBILITY IN ADOLESCENT IDIOPATHIC SCOLIOSIS

F.Erkal BİLEN^{(1)(B)}, Ufuk TALU^{(2)(O)}, Mehmet TEZER^{(3)(O)}, Cüneyt MIRZANLI^{(4)(O)},
Ünsal DOMANIÇ^{(2)(O)}, Azmi HAMZAOĞLU^{(1)(O)}

Institution(s)

¹⁾ *Istanbul Spine Center; Florence Nightingale Hospital*

²⁾ *Istanbul University Medical Faculty; Çapa Topkapı, 34390 Istanbul*

³⁾ *Şişli Etfal Hospital; Şişli Istanbul*

⁴⁾ *SSK Vakıf Gureba Hastanesi; Topkapı Istanbul*

Purpose: Along with magnitude, flexibility of a scoliotic curve has always been a major determinant for preoperative planning and surgical outcome for adolescent idiopathic scoliosis (AIS). The purpose of this study was to use and evaluate mostly accepted or described radiologic techniques or methods to determine flexibility and compare the results to those obtained by supine traction X-rays under general anesthesia just before surgery and correlate all findings to surgical correction.

Methods: 34 consecutive AIS patients who had surgical treatment were studied. 25 were female, 9 were male and average age was 15.7 (12-19) years. Preoperative radiologic evaluation consisted of standing AP and lateral, supine lateral bending and traction, fulcrum X-rays and also supine traction X-rays under general anesthesia (GA) just before surgery. All structural curves were measured and flexibility ratio was determined on each radiograph. Calculated values were correlated with amount of surgical correction achieved by pedicle screw instrumentation.

Results: Curves were accepted to be moderate if between 40° and 65° (29 patients) and severe if >65° (5 patients). In these 29 patients, average frontal Cobb angle of the thoracic and lumbar curves were 39P (40° -60°) and 39.4° (22° -58°) respectively. Average thoracic curve flexibility was 49 % (23 %-64 %) at traction, 79 % (30 %-88 %) at traction under GA, 66 % (25 %-82 %) upon lateral bending and 74 % (50 %-87 %) at fulcrum X-

rays. Average surgical correction of the thoracic curve was 76 % (52 %-95 %). Average lumbar curve flexibility was 56 % (35 %-73 %) at traction, 59 % (39 %-72 %) at traction under GA, 81 % (61 %-100 %) upon lateral bending and 83 % (66 %-100 %) at fulcrum X-rays. Average surgical correction of the lumbar curve was 74 % (44 %-100 %). In the other group of 5 patients, average frontal Cobb angle of the thoracic and lumbar curves were 79° (47°-110°) and 67° (38°-90°) respectively. With the same order above, average thoracic curve correction was 35 % (29 %-38 %), 52 % (49 %-58 %), 43 % (35 %-55 %) and 45 % (41 %-50 %). Also average lumbar curve correction was 40 % (32 %-50 %), 60 % (45 %-79%), 51 % (40 %-65 %), 53 % (38 %-69 %). Average surgical correction of the thoracic and lumbar curve in this group were 68 % (64 %-72 %) and 63 % (42 %-79 %) respectively.

Conclusion: Traction under GA > fulcrum > bending > seems to be the order of X-rays for better predicting flexibility and correction in curves > 65°. Pedicle screw instrumentation however provides even more correction than are obtained by traction under GA. On the other hand fulcrum > bending > traction under GA > is the order of X-rays for better predicting flexibility and correction in curves between 40°-65°. Amount of surgical correction in this group is either close or equivalent to correction at fulcrum x-rays. Traction X-ray under GA may show much better flexibility and thus it may eliminate the need for anterior surgery in seemingly rigid, > 65° curves.

EVALUATION OF TITANIUM MESH CAGES USED FOR ANTERIOR COLUMN SUPPORT FOLLOWING CORPECTOMY IN THE THORACIC AND LUMBAR (TI-SI) REGION WITH MINIMUM TWO- YEAR FOLLOW-UP

Oğuz KARAEMİNOĞULLARI^{(1)(B)}, Mürsel DEBRE^{(2)(O)}, F.Erkal BİLEN^{(2)(O)},
Ufuk TALU^{(3)(O)}, Ünsal DOMANIÇ^{(3)(O)}, Azmi HAMZAOĞLU^{(2)(O)}

Institution(s)

¹⁾ Izzet Baysal University Medical Faculty; Düzce

²⁾ Istanbul Spine Center; Florence Nightingale Hospital Çağlayan Istanbul 80220

³⁾ Istanbul University Medical Faculty; Çapa Topkapı Istanbul 34390

Purpose: There are some studies on mesh cages used as interbody fusion devices after discectomy. To our knowledge, there is no clinical study analyzing titanium mesh cages (TMC) used for anterior column support following corpectomy. Our purpose was to evaluate the clinical and radiologic results and complications after thoracic and lumbar level corpectomy and reconstruction using TMC with either anterior instrumentation, posterior instrumentation or a combination of all and to determine ideal configuration.

Methods: 29 adult patients who had thoracic and/or lumbar corpectomy for various reasons (17 fractures, 5 spinal tuberculosis, 5 deformity) were included. Average age was 48.6 (17-86) years and follow-up ranged from 24 to 56 (mean, 28) months. Total 36 level corpectomy (min 1, max 4 levels) was performed. Structural TMC filled with autogenous bone graft was used for anterior column. In addition to TMC and on the same day, 2 had only anterior, 20 had only posterior and 7 had anterior and posterior instrumentation. Standing AP and lateral, supine AP, lateral and both oblique X-rays and high resolution CT reconstruction have been used to assess fusion status for TMC in the anterior column. Sagittal Cobb measurements were obtained across all consecutive levels containing anterior TMC for every patient's preoperative, immediate postoperative and 2 year postoperative radiographs. Besides the status of anterior and posterior instrumentation, anterior cage status

was assessed for settling, migration and/or fatigue. Fusion status for TMC was assessed according to a previously published (Bridwell et al, 1995) fusion grading system. More than 2 mm settling and 4° correction loss were accepted to be significant.

Results: Mean immediate postoperative sagittal correction was 25.6° (8°-60°). Mean correction loss was 0.9° (0°-8°). There was no failure of anterior and posterior instrumentations. No cage failure or migration was observed. There was no pseudarthrosis and fusion was achieved in all patients. 6 (20.6 %) showed cage settling of more than 2 mm. Of these 3 had more than 4° and 3 had less than 4° correction loss. These patients with significant settling and correction loss were either osteoporotic with damaged end-plates or no end-plate collar was used in the TMC.

Conclusions: The configuration consisting of TMC+anterior single rod instrumentation+short segment posterior instrumentation after corpectomy involves no correction loss and cage settling and seems to be the ideal solution. There is a risk of correction loss and cage settling in osteoporotic patients when only short segment posterior instrumentation is used, especially with no end-plate collar in the TMC.

Posterior instrumentation after corpectomy should be two level above and below in patients with previous laminectomy and serious sagittal plane deformity.