



POSTERIOR TOTAL WEDGE RESECTION OSTEOTOMY FOR SURGICAL TREATMENT OF RIGID KYPHOSIS

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INTRODUCTION: Anterior and posterior procedures are usually combined for the surgical treatment of severe, rigid and local kyphosis secondary to trauma, infection, congenital anomalies, etc. In such cases a one-stage solution would be a posteriorly based, wedge-resection osteotomy which results in shortened posterior column and decreased tension on spinal cord.

PATIENTS: Between 1990 and 1994, 20 patients with rigid local kyphosis were surgically treated by posterior wedge osteotomy and Cotrel-Dubousset instrumentation. Etiology was congenital malformation in 8, infection in 9 and previous laminectomy in 3 cases.

OPERATIVE TECHNIQUE: The osteotomy is performed at the apex of the kyphotic deformity and covers two vertebrae. Upper and lower border of the osteotomy are right inferior to the transverse processes of the upper and lower vertebrae respectively. Apex of the posteriorly based triangular osteotomy is either at the anterior vertebral body or anterior longitudinal ligament. A complete laminectomy and facetectomy is performed at the posterior resection si-

te and than lateral wall of the spinal canal is excised bilaterally. The spinal nerves are carefully dissected and preserved. Once the osteotomy and wedge resection are completed the left portions of the upper and lower vertebrae form an intervertebral foramen containing two spinal nerves on both sides at the resection site.

RESULTS: The mean pre-operative angle of local kyphosis was 89° (range 60° -112°) and it improved to a mean of 2.7 degrees (range 20° -48°) postoperatively after an average follow-up of 64 months (range 48-96). Fusion was achieved in all cases. Mean loss of correction at follow-up was 4° and one patient (5%) had postoperative neurologic deficit.

CONCLUSION: Posterior total wedge resection osteotomy eliminates the need for anterior procedure and does not cause tractional force on the spinal cord since the posterior column is shortened. It is an effective one-stage procedure especially for the treatment of sharp and rigid kyphosis.

THE EFFECT OF TRANSPEDICULAR INTRACORPORAL GRAFTING IN THE TREATMENT OF THORACOLUMBAR BURST FRACTURES ON CANAL REMODELING

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PURPOSE: Transpedicular intracorporal grafting in combination with short segment instrumentation has been offered as an alternative to prevent failure. The concern still exists about the potential complication of further canal narrowing or failure of remodeling with this technique. This study prospectively evaluated canal remodeling in patients treated with transpedicular intracorporal grafting.

PATIENTS AND METHODS: Twenty-one patients with thoracolumbar burst fractures were randomized into transpedicular grafting (TPG) (n= 11) and non- TPG (NTPG) (n= 20) groups and were prospectively followed for an average of 50 months (25- 85). Groups were similar for age, type of fracture, load sharing classification and kyphotic deformity.

Preoperative, postoperative and follow-up CT images through the level of pedicles were obtained, corrected for differences in magnification, and digitized. Areas of the spinal canals were measured and normalized by the estimated area at that level (average of adjacent levels).

RESULTS: There were no operative complications in any of the groups. Average sagittal index was 19.7 ± 6.2 degrees at presentation, was corrected to 1.9 ± 4.9 degrees by operation,

but was found to have been deteriorated to 9.1 ± 6.4 degrees at final follow-up. There were no differences between groups regarding the evolution of sagittal deformity. Spinal canal narrowing was 38.5 ± 18.2 % at presentation, 22.1 ± 19.8 % postop, and further improved to -2.5 ± 16.7 % at follow-up, similar for both groups (Table 1).

Canal Narrowing	TPG	NT PG	P value
Pre-operative	40.5±16.9%	36.1±20.4%	0.601
Post-operative	24.2±20.6%	19.6±20.0%	0.648
Correction	15.9±14.0%	18.5±14.3%	0.969
Follow-up	0.4±10.9%	-5.4±21.3%	0.476
Remodeling	27.8±20.3%	24.5±11.8%	0.109

DISCUSSION: Our results demonstrate that transpedicular intracorporal grafting in the treatment of burst fractures does not affect the rate of reconstruction of the canal area as well as remodeling. Spinal canal remodeling was observed to occur in all patients regardless of grafting, eventually leading to overcorrection in some. On the other hand, it was also seen that this technique is not effective in preventing the deterioration of radiological findings in patients treated with short segment posterior instrumentation.

THE THREE DIMENSIONAL EVOLUTION OF SCOLIOTIC CURVATURE DURING INSTRUMENTATION WITHOUT FUSION IN IMMATURE PATIENTS

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PURPOSE: To evaluate the evolution of scoliotic curves until definitive fusion in immature patients that had undergone single rod distraction instrumentation without fusion (SCR).

PATIENTS AND METHODS: 1 Twelve patients who had been followed till definitive fusion were retrospectively evaluated. Patients were evaluated for any changes in the magnitude of their deformities in frontal, sagittal and transverse planes. Average patient age was 5.8 ± 2.4 years at the time of SCR, and 11.3 ± 1.6 years at definitive surgery. Average follow-up was 5.5 ± 1.9 (2-8,5) years.

RESULTS: it was seen that average number of lengthening operations per patient was 4.6 ± 1.8 (2-7), number of all operations per patient was 7.1 ± 2.6 (4-13). Average number of complications per patient was 1.9 ± 2.2 (0-6). Average time spent in hospital was 104 ± 69 (30-262) days. A summary of results can be seen on Table 1.

Average curve flexibility index was 46.7:1:10 at the time of SCR. At definitive surgery an average of 3.3:1:2.7 posterior osteotomies were required so as to obtain any flexibility, because of facet ankylosis.

DISCUSSION: Our findings demonstrate that, the curves were essentially unchanged in the frontal plane during the period of lengthening. The sagittal curves remained mostly within the limits of normal, but there was an alarming increase in rotation. Curves could be corrected to the level obtained at first SCR operation at the time of definitive surgery. Definitive surgery following SCR is very complex and requires facet osteotomies at multiple levels, yielding only 41.4% correction. It was concluded that, SCR with a single distraction rod was effective in preserving the frontal deformity for an average of 5.5 years, but was ineffective in controlling any increases in transverse plane deformity.

Ave:1 :Sn (range)(°)	Pre-SCR	Pre-def.surg r	% change during SCR	Post-def.surg
Fro. Cobb	58.7 ± 12.2 (40-90)	59.6 ± 12.1 (45-78)	7.4 ± 18.8 (-27 - 35)	34 ± 7.7 (22-45)
Apical toL	20.2 ± 7.3 (10-35)	33.2 ± 5.2 (25-42)	42.6 ± 18.3 (0-67)	
Th. Kyph.	30.1 ± 10.7 (10-48)	40.9 ± 9.8 (20-52)		41.8 ± 10.9 (25-55)
Lum. Lord	39.7 ± 11.6 (24-65)	47.8 ± 16.3 (18-80)		50.3 ± 7.1 (40-60)

HORIZONTAL GAZE PALSY AND SCOLIOSIS

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AIM: We report a group of patients with horizontal gaze palsy (HGP) associated with scoliosis.

MATERIAL AND METHOD: HGP associated with scoliosis was found in 7 cases in 2 families, each having 3 cases and in one sporadic case. In Family 1 two generations, in Family II three sisters in the same generation were affected.

RESULTS: Scoliosis of varying degree, low amplitude horizontal pendular nystagmus and loss of conjugate horizontal eye movements

were common in all patients. Female patients of this family had also genital dysgenesis, which was not previously reported. Scoliosis was early onset and progressive in nature in all patients. Cranial and spinal magnetic resonance imaging revealed no anomaly. Neurologic examinations were otherwise normal.

CONCLUSION: it was concluded that HGP associated with scoliosis constitutes a distinct clinical entity. This disorder appears to be caused by a malfunction of the normal central control mechanisms related to the brainstem.

RISK FACTORS OF DE NOVO SCOLIOSIS IN THE ELDERLY

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PURPOSE: The main purpose of this study was to analyze the age related degenerative process in the lumbar spine, in order to determine potential risk factors related to the evolution of de novo scoliosis in the elderly.

METHODS: This prospective study includes 121 adults (>50 years of age) evaluated by medical history, physical examination, and standing spinal roentgenograms. Cases with prior history of scoliosis, trauma or spinal surgery were excluded. Analyzed radiological parameters included: degree of listhesis (%), ewedging (%), and height of each lumbar vertebra, wedging (%), and height of disc, length of vertebral spurs, lumbar lordosis, lumbosacral, lumbo (LS) horizontal and sacro-horizontal angles, sagittal indexes, pelvic tilt on A-P X-ray, depth of LS from the intercrest line, also -if present curve pattern [size, side, length, rotation, location, # of curve], and level presented with the most obvious degenerative changes [MODC]. Uni- and multi-variate statistical methods were used for analysis.

RESULTS: There were 33 male and 88 female with the mean age of 63±7 years (range, 50-93). Scoliosis (> 10° Cobb angle) was found in 35 cases, with an average curvature of 15±6° (range, 11-37). Low back pain and leg pain were more common in women (Fisher's Exact Test, p=0.004, p=0.003) and in cases with sco-

liosis (Fisher's Exact Test, p=0.001, p=0.046). Asymmetric disc collapse and spur formation were most obvious at the L3-4 disc level, whereas, on A-p X-rays, wedging and listhesis were most frequently seen at the L3 vertebra. MODC at L2-3 and L4-5 disc levels were significant more frequent in cases with scoliosis (MannWhitney U test, p=0.010, p=0.011, respectively). Upon multivariate analysis lateral listhesis of L3, asymmetric collapse of L3-4 disc, and pelvic tilt on A-P X-ray were risk factors significant for the formation of scoliosis (p=0.000, p=0.000, p=0.001, respectively). If only cases with scoliosis were evaluated, MODC at the L3-4 disc level, and a more cranial apex of curve were predictive for a higher degree of scoliosis, where as MODC at the L5-S1 level was related to lesser degree of scoliosis (multivariate regression test, p=0.009, p=0.017, p=0.009, respectively).

CONCLUSIONS: Degenerative changes in the middle lumbar region (particularly at L3-4 disc level), and pathologic conditions in the hip or lower extremities resulting in pelvic tilt, seem to be important risk factors in the evolution of degenerative adult scoliosis. Likewise, asymmetric degenerative changes at the L3-4 disc level, and a more cranial apex of curve was predictive for an increase of scoliotic curve.

RESULTS OF ANTERIOR INSTRUMENTATION FOR ADOLESCENT IDIOPATHIC SCOLIOSIS

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OBJECTIVES: To review the charts and radiographs of patients with adolescent idiopathic scoliosis who underwent anterior correction and fusion with rigid single rod third generation instrumentation and titanium mesh cages and to analyze their coronal and sagittal plane corrections, spontaneous secondary curve corrections, balance, number of fused segments and saved lumbar levels, complications and early follow-up results.

PATIENTS AND METHODS: 32 patients with a mean follow-up of 31 months (range 24 - 45 months) were included in this study. Mean age was 14.9 years. There were 8 patients with King Type I, 10 with Type II, 6 with Type III, 4 with Type LV and 4 with lumbar curves. Titanium mesh cages were used in all lumbar procedures and at the cranial and caudal ends of the instrumented area in thoracic cases. After giving the proper sagittal contour, the rod was first fixed to the most distal segment and then correction was achieved by performing translation with cantilever maneuver. In thoracic curves mesh cages were especially used for the upper one or two disc spaces in order to prevent pull-out of the most proximal screw and junctional kyphosis above instrumentation. All patients were immobilized in an orthosis for 3 to

6 months postoperatively. Pre-operative, post-operative and follow-up radiographs were reviewed.

RESULTS: Mean pre-operative primary coronal Cobb angle of 51 ° was improved to 8.6°. Average correction rate was 83.9%. Sagittal balance was also restored to a mean thoracic kyphosis of 27.5° and a mean lumbar lordosis of 37.6°. Spontaneous secondary curve decompensation never occurred. Mean number of lumbar levels saved in comparison to posterior surgery was calculated as 0.93. Thoracolumbar junctional kyphosis after surgery was not seen. Loss of correction, nonunion and implant failure did not develop except in one case who had anterior thoracic curve correction and was revised with posterior surgery and instrumentation for the most proximal screw pull-out.

CONCLUSION: Our early results dictate that anterior correction using 3. generation single solid rod instrumentation in combination with titanium mesh cages offers a good alternative to posterior instrumentation and provides some advantages like better axial and sagittal plane corrections, fusing shorter segments, avoiding secondary curve decompensation and also obtaining a better cosmesis.

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

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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 discs.

MATERIAL AND METHODS: Fifteen consecutive neurologically intact patients with burst fractures 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 neighboring 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 signal intensity of nucleus pulposus (NP) in 8 of the cranial and in 5 of the caudal adjacent discs. On followup MRI, there was only one intact disc with anormal 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 neighboring 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. Conservative treatment based on integrity of PLC is controversial, probably due to poor evaluation by clinical and indirect radiographic findings.

CONCLUSION: An intact PLC may not prevent loss of correction gained by nonsurgical 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.

Table1. The results of x-ray analysis

	PRE-TREATMENT	POSTTREATMENT	3RD MONTH FIUP	LATEST FIUP
LK (degrees)	16.5 (0-34)	5 (-19-25)	14,6 (4-24)	18 (4-29)
Si (degrees)	18 (0-27)	10 (-2-21)	15,6 (-2-23)	19 (4-34)
ABH(%)	30 (5-57)	19 (3-36)	28 (10-52)	39 (12-60)

**THE EFFICACY OF CONVEX HEMIEPIPHYSIODESIS IN PATIENTS WITH
IATROGENIC
POSTERIOR ELEMENT DEFICIENCY DUE TO DIASTEMATOMYELIA
EXCISION**

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PURPOSE: Anterior and posterior convex hemiepiphyodesis is a well accepted treatment method for severe and progressive congenital scoliosis in young children. Many patients with congenital spinal deformities have intraspinal pathologies that require neurosurgical intervention with laminectomy. The efficacy of this method has not been studied in these patient populations. The purpose of this study is to investigate the safety and efficacy of anterior and posterior hemiepiphyodesis in patients with iatrogenic posterior element deficiency.

MATERIALS & METHODS: Between 1990-2001, 82 patients with congenital spinal deformity were treated with convex epiphyodesis. Sixteen patients (2 male, 14 female) who underwent diastematomyelia excision and were followed up for at least 2 years were included. Diastematomyelia excision was performed before the orthopaedic procedure in 8 patients and at the same stage in 8 patients. Mean age at the time of the fusion was 18 months (6-48)

and, average follow-up was 41 months (24-120).

RESULTS: The mean Cobb angle was 580 (31°-115°) preoperatively and, 54° (30°-90°) at final follow-up. Any increase more than 6 degrees was accepted as progression. Seven patients (44%) had a true epiphyodesis effect [64°(40-115) preoperatively, and 49° (30°-90°) at follow-up]; 7(44%) patients had a fusion effect [50°(31°-68°) preoperatively and 53°(36°-73°) at follow-up]. Two patients (12%) had a postoperative progression of deformity [63°(54°-72°) preop. and 75°(65°-84°) follow-up].

CONCLUSION: Convex epiphyodesis is an effective method in patients with midline laminectomy defect as is in the patients with intact posterior elements. Since the facet joints and transverse processes are usually unaffected, the presence of midline defect does not diminish the efficacy of the technique.

ASSESSMENT OF CURVE FLEXIBILITY IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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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 39.7° (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 was 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.

RISK FACTORS OF POSTOPERATIVE DEEP WOUND INFECTIONS IN SPINAL INSTRUMENTATION, ANALYSIS OF 869 CASES

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AIM: Postoperative deep wound infection is a major and devastating complication of spinal instrumentation. The aim of this study is to determine and evaluate the risk factors of postoperative deep wound infections in spinal instrumentation.

MATERIALS AND METHODS: The study group includes 29 deep wound infection cases and age, sex, etiology matched 92 control cases among 869 cases with spinal instrumentation between 1989 and 2000. Cases were also grouped as early and late onset infection cases and their matched control groups. Recorded variables were age, sex, etiology, body mass index, year, duration and type of operation, implant material, number of segments involved, paraplegia, duration of preoperative hospitalization, duration of urinary catheter, history of smoking, polytrauma. Possible other factors not available for statistics were given 1 point each and cumulating was computed as a risk factor (diabetes mellitus, massive transfusion, long stay in ICU, pre and post long-lasting wound drainage, etc.). Chi-square, students-t, Mann-

Whitney-U, ANOVA tests and logistic regression model were used for statistics.

RESULTS AND CONCLUSION: Logistic regression analysis revealed that the most important risk factors were staged surgery ($p=0.005$), preoperative hospitalization more than 4 days ($p=0.042$), polytrauma ($p=0.012$), paraplegia ($p=0.039$), having more than 1 point of other possible factors cumulating ($p=0.005$). Duration of urinary catheters ($p=0.007$), duration of operation (more than 210 minutes, $p=0.022$) and segments involved (segments between 4-7, $p=0.006$) were other risk factors in decreasing importance. Body mass index was a risk factor for adult patients ($p=0.024$). Staged spinal surgery increased risk of infection 6 times (risk is 10.5 times higher in early onset group) and hospitalization preoperatively more than 4 days increased risk of infection 6 times (risk is 5.3 times higher in early onset group). For late-onset infection group, only duration of urinary catheters and having more than 2 points of other possible factors was found to be important risk factors ($p=0.009$ and $p=0.040$ respectively).