

Posterior instrumentation for unstable thoracolumbar fractures

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Abstract

Background: About 90 percent of all spinal injuries involve the thoracolumbar region. Unstable fractures need surgical treatment to achieve a painless, balanced and stable spine preserving or recovering neurological function, highest degree of spinal motion and to allow early patient mobilization.

Objective: This study was carried out to evaluate radiological outcome of posterior instrumentation in thoracolumbar fractures.

Methodology: A total of 110 patients with thoracolumbar fracture were included in the study, which was carried out at Kathmandu Medical College Teaching Hospital from December 2011 to December 2016. Unstable Arbeitsgemeinschaft fur Osteosynthesefragen type A and type B fractures were treated with short segment instrumentation and type C with long segment instrumentation. Radiological evaluation of postoperative correction of kyphotic angle and vertebral height was measured and was compared with immediate postoperative correction and loss of correction in two years final follow up.

Results: Mean postoperative correction of vertebral kyphotic angle was 25° and loss of correction in final follow up was 5°. Mean postoperative vertebral height correction was 24% and its loss in final follow up was 2%. There was no significant difference in loss of correction of vertebral kyphosis and vertebral height in short segment and long segment fixation in final follow up.

Conclusion: Long segment posterior instrumentation results in good reduction and its maintenance for Arbeitsgemeinschaft fur Osteosynthesefragen type C thoracolumbar fractures whereas similar results can be achieved with short segment posterior instrumentation in type A and type B fractures.

Key words: Posterior instrumentation, Spine, Thoracolumbar, Unstable fractures

INTRODUCTION

About 90 percent of all spinal injuries involve thoracolumbar region^{1,2}. Various methods of treatment have been advocated³. There had been controversies between operative and non operative approaches²⁻⁴. Mostly stable fractures are treated nonsurgically and unstable fractures are treated surgically^{3,5}. Regarding burst fracture there has always been debate between operative and conservative methods of treatment^{1,6-8}. Surgical treatment can be either anterior or posterior or combined anterior and posterior^{2,9,10}. Posterior fixation with pedicle screw

fixation gives three-column fixation and is considered as most stable construct. Posterior instrumentation can be of mono segmental, short segmental or long segmental and can also be with or without fusion^{11,12}. Highly unstable fractures need long segmental fixation whereas lesser unstable fractures can be stabilized with short segmental instrumentation¹³. Always there remained controversies regarding level of instrumentation. Long segmental fixation gives good stability but reduces motion segments whereas short segmental fixation is less stable but preserves motion segments^{4,5,14}. This study was carried out to evaluate radiological outcome of posterior instruments in thoracolumbar fractures.

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METHODOLOGY

This is a prospective cohort study carried out at Kathmandu Medical College Teaching Hospital from December 2011 to December 2016. Ethical clearance was achieved from the hospital ethical committee.

Total of 110 patients with thoracolumbar fracture with or without neurological involvement and with at least two years of follow up were included in the study. Indication of surgery was decided by Thoracolumbar injury Classification and Severity Score (TLICS)¹⁵ and morphology of fracture was classified with AO (Arbeitsgemeinschaft für Osteosynthesefragen) classification¹⁶. Fractures up to AO A 3.1 were excluded as they were treated conservatively.

Under general anesthesia patients were placed on operation table in prone position with two transverse rolls under the chest and pelvis. By securing this position spine becomes hyperextended and reduction can be achieved to some extent. Abdomen remains free to decrease intra-abdominal pressure. A standard midline posterior incision was used centering the injured vertebra. Sub periosteal dissection was done to expose all the posterior elements up to the tip of transverse process. Entry point for pedicle screw insertion was then identified. In the thoracic vertebra the point was identified lateral to a vertical line bisecting the facet joint along the upper one third of the transverse process. For lumbar vertebra same point was identified along the lateral aspect of the facet joint, where they intersect a line passing through the middle portion of the transverse process. Pedicle probe was inserted to cannulate the pedicle with C-arm control in lateral view. The tract was checked for pedicle breach with pedicle sound. Screw diameter was estimated by measuring pedicle diameter in axial CT scan. Pedicle screws were inserted in fractured vertebra also if pedicles were found intact in CT scan. After insertion of screws, the rods were contoured to the normal sagittal curvature of the spine to achieve adequate reduction. Rods were first inserted in proximal screws and then pushed into distal screws. By doing this maneuver angular deformity was corrected to some extent. Distraction between proximal and distal screws was done to restore vertebral height and to decompress the spinal canal with ligamentotaxis. AO type A and type B fractures were treated with short segment instrumentation (one vertebra above and one vertebra below the fracture) (Figure 1a-1c). Type C fractures were treated with long segment instrumentation (two vertebrae above and two vertebrae below the fracture) (Figure 2a-2d). In short segment instrumentation pedicle screws were inserted in fracture vertebra if pedicles were intact. In those cases where pedicle screws were not inserted cross-link was attached between two rods to increase strength of the implant. In long segment instrumentation cross-link was attached between the rods. Posterior fusion was done in fractures with posterior ligamentous complex disruption.

Bone graft was taken from the spinous process of vertebrae to be fused. Patients were ambulated with brace for about three months postoperative. Follow up X-rays were done in six weeks, three months, six months, one year and two years. Kyphotic angle was measured as the angle between the parallel lines of upper margin and lower margin of the vertebral body in lateral view of X-ray of spine. Its immediate postoperative correction and loss of correction in final follow up were compared. Vertebral height reduction was measured by percentage of the posterior body height of fractured vertebra with average posterior height of body of immediate upper and lower vertebrae. Percentage of vertebral body height reduction, its postoperative correction and its loss in final follow up were compared. Complications were recorded. Statistical analysis was performed with SPSS (Chicago, Illinois, USA) version 15 software for windows. Student's t-test was used for statistical analysis to determine significance. P-value of 0.05 or less was considered significant.

RESULTS

The total number of cases operated in this period was 185. One hundred and ten patients, who came for follow up for two years were included in this study. Among them there were 72 males and 38 females. The mean age of the patients was 38.4 (18-54) years. L1 fracture was found in 35 (31.81%) of the patients, D12 in 31 (28.18%), L2 in 18 (16.36), D11 in 8 (7.27%), D10 in 5 (4.54%) and rest of the dorso-lumbar fracture was in 13 (11.81%) of patients. There were 56 AO type A patients, 31 type B and 23 type C. Mean (standard deviation) preoperative kyphotic angle was 25° (± 8.5) and immediate post operative was 6° (±3.2). Mean postoperative correction in kyphotic angle was 19°. Mean kyphotic angle in final follow up was 11° (±2.4). Loss of kyphotic correction in final follow up was 5° (±4.2). Preoperative average vertebral height reduction was 29% (±9.3) and was 5% (±4.2) postoperatively. Mean postoperative correction of vertebral height was of 24%. Mean vertebral height reduction in final follow up was 7% (±5.3). Hence loss of vertebral height correction was 2%. Kyphotic angle correction and vertebral height restoration was better in postoperative period. Though there was loss of kyphotic angle correction and loss of vertebral height correction in final follow up, they were not statistically significant. Among AO type A and B fractures, where short segment fixation was done, post operative kyphotic angle correction was of 28° (±7.3) and among AO type C fractures, where long segment fixation was done, it was 16° (±8.5). Loss of kyphotic angle correction in final follow up in short segment fixation group was 6° (±3.5)

and in long segment fixation group it was 4° (±2.2). There was no statistically significant difference of these parameters in short segment and long segment fixation groups. Post-operative increase in vertebral height was 18% and 24% in long segment and short segment fixation respectively. Loss of vertebral height correction in both the groups was 2% and 3% respectively. These parameters were not significantly different. There was no significant difference in final radiological outcome among the patients with intermediate pedicle screw in fracture vertebra and patients with cross link group. Posterior fusion with bone graft was done in 45 patients. There was no significant difference between the results in fusion and non fusion group in mean postoperative kyphotic angle correction and loss of correction in final follow up. Similarly there was no difference in mean immediate postoperative height correction and in final follow up in these two groups (Table 1).

Postoperative wound infection was found in seven patients (6.3%). Superficial wound infection healed with regular dressing and appropriate antibiotic. Deep infection needed debridement and sensitive antibiotics for the control of infection (Table 2). Finally wound healed without removing the implants. Implant failure was found in seven (6.3%) patients. One patient (0.9%) had postoperative cauda equina syndrome, which

recovered subsequently. Bladder and bowel function recovered, however there was mild motor weakness in one lower limb at the end of two years follow up.

DISCUSSION

About 50 to 88% of spine fractures occur at the dorso-lumbar junction^{7,8,13}. In our study 92 (83.63%) of the fracture were in dorso-lumbar junction (D11-L2). The treatment of thoracolumbar fracture remains challenging and debatable. Posterior instrumentation with pedicle screw fixation provided sufficient stability^{5,13,18-21,23,24}. Payer⁷ reported loss of kyphosis correction of 3° with no implant failure in treatment of unstable thoracolumbar fractures using posterior instrumentation with anterior support. Been et al.¹⁷ conducted comparison of combined anterior and posterior stabilization versus posterior instrumentation only for thoracolumbar burst fractures and found loss of reduction greater than 5° and instrumentation failure significantly more in posterior instrumentation only group, but the kyphosis angle at late follow-up (average of 6 years) did not differ between the groups. In our study immediate post-operative kyphosis correction was 19° and loss of correction in final follow up was 5°. There was 24% of immediate postoperative correction of vertebral height with 2% of loss of correction in final follow up.

Table 1: Comparison between fusion and non-fusion cases

	Fusion group (N= 45)	non-fusion group (N=65)	p
Mean post-operative kyphotic angle correction Degree (SD)	21 (4.5)	23 (5.2)	0.61
Mean loss of kyphotic angle correction in final follow up Degree (SD)	4 (2.6)	5 (3.1)	0.74
Mean post-operative increase in vertebral height Percentage (SD)	19 (2.5)	21 (3.2)	0.81
Mean loss of vertebral height correction in final follow up Percentage (SD)	3 (2.5)	3 (2.9)	0.71

SD= standard deviation

Table 2: Complications

Complications	Number (%)	Remarks
Wound infection	7 (6.3 %)	
Deep	2 (1.8%)	Healed with wound dressings
Superficial	5 (4.5%)	
Implant failure	7 (6.3%)	
Screw breakage	2 (1.8%)	Fusion – 1
Rod breakage	2 (1.8%)	
Cap failure	3 (2.7%)	Non fusion – 6
Post-operative cauda equina	1 (0.9%)	



1a.



1b.



1c.

Figure 1a: Pre-operative CT image of burst fracture of L3 vertebra

Figure 1b: X-ray of Lumbar Spine in post-operative period

Figure 1c: X-ray in final follow up



2a.



2b.



2c.



2d.

Figure 2a: Pre-operative X-ray of fracture dislocation of D12 vertebra (AO type C)

Figure 2b: Pre-operative CT scan

Figure 2c: Post-operative X-ray

Figure 2d: X-ray in final follow up

Regarding posterior instrumentation there are options of long segmental and short segment fixation. Short segment posterior instrumentation preserves motion segments whereas long segment fixation gives more stability^{5,13,18,19,20,21}. Butt et al.¹³ in their study found 3.46° of loss of kyphosis correction and 3% loss of vertebral height in final follow-up with short segment fixation. We found 6° of loss of kyphotic angle correction in final follow in short segment fixation with three percent of loss of vertebral height correction. In our study short segment fixation was done only in unstable burst fracture and flexion distraction injuries. Regarding long segment fixation we found four degree loss of

kyphotic angle correction and two percent of loss of vertebral height restoration in final follow up. Tezeranet al.²¹ showed that long segment group had better outcome at final follow-up. Short segment group had a 55% failure rate. Scholl et al.²² observed posterior instrumentation with two levels above and one level below the fracture vertebra had lower failure rate than one level above and one level below instrumentation. Mahar et al.²³ and Norton et al.²⁴ reported that additional screws in fracture vertebra (intermediate screws) gives better reduction and kyphosis correction. We found no significant difference in radiological final result in the patients where intermediate screw were used.

We found there was no significant difference in the results of fusion and non fusion cases in terms of kyphotic angle correction and vertebral height maintenance. Fusion always lowers the risk of implant failure^{25,26}. Hwang et al.²⁷ concluded that implant related complications were less in fusion group. Whereas some studies demonstrated that spinal fusion is not necessary in long segment and short segment posterior instrumentation^{26,28-30}. In our study there was seven (6.3%) implant failure. Six (5.4%) of them were with non-fusion instrumentation.

We had infection in seven (6.3%) cases, out of which there were two (1.8%) superficial and five (4.5%) deep. Two

cases with deep infection were treated by debridement and appropriate antibiotic for longer period. Superficial wound infection was treated with regular wound dressing and proper antibiotics. Various studies showed post-operative wound infection rate increases up to 25% in paralytic cases³¹⁻³³.

CONCLUSION

Short segment posterior instrumentation results in good reduction in unstable burst and chance fractures and long segment posterior instrumentation results in good reduction in thoracolumbar fracture dislocation.

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