

Functional and radiological outcomes of instrumentation and decompression in thoracolumbar fractures

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Abstract

Introduction: Thoracolumbar fracture can be stabilized adequately by utilizing posterior decompression by performing pedicle screw fixation. The neurological progress of such patients was analyzed by using the American Spinal Injury Association (ASIA) chart

Purpose: We aimed to assess the functional, radiological, and neurological outcomes of 31 patients who have suffered thoracolumbar fractures.

Materials and Methods: 31 patients underwent posterior decompression by pedicle screw fixation in order to treat their thoracolumbar fractures at Vydehi Institute of Medical Sciences and Research Center. The American Spinal Injury Association neurological chart, Visual Analogue Score, and Kyphotic Angle were used to gauge the functional progress of the patients. Patients were followed-up regularly.

Results: Upon comparing the mean preoperative, postoperative, and final follow up data of this study, the neurological improvement, as indicated by the ASIA neurological chart, was highly significant as well as successful. Only two patients had screw breakage without worsening of neurological status. Five of the 31 patients developed minor complications for which they were treated.

Conclusion: Posterior decompression by pedicle screw fixation is a viable option for patients who have suffered unstable thoracolumbar fractures with any deformity or neurological dysfunction.

Keywords: Thoracolumbar Fractures, Posterior decompression, Pedicle screws, Functional outcomes, Orthopedic surgery

Introduction

Thoracolumbar fractures are usually the result of high energy trauma due to which patients require immediate evaluation. Due to its anatomical placement between the rigid thoracic and the flexible lumbar spine, the thoracolumbar junction is the most prone site for spinal injury. A high significance of neurological deficits, as well as painful kyphotic deformity may significantly impair the quality of life in these patients.

The mechanical stability of the fracture should be evaluated by plain radiographs and computed tomography, and in some cases magnetic resonance imaging to assess the degree of soft tissue damage involving neurological structures and/or the posterior ligament complexes. Based on physical examinations and the above mentioned imaging studies, fracture stability is evaluated, and it is determined whether to use conservative or operative treatment modalities.⁽¹⁾

The optimal management option has been a matter of debate. Strategies include anterior and posterior approaches (with placement of an iliac bone graft or prosthetic cage) as well as a combined approach.

Anterior approach offers good exposure to the vertebral body. However, little access to the posterior elements can cause potential complications. Combined approach (anterior and posterior) provides access to both anterior and posterior elements, but several intraoperative complications make this procedure not ideal. Recent studies have mentioned that adequate

circumferential decompression and stabilization is possible through posterior approach alone, thereby reducing surgical time, blood loss, infection and overall morbidity of the patients.^(2,3)

In this study, we looked into the stabilization of thoracolumbar fractures after using posterior decompression by performing pedicle screw fixation. Neurological progress was assessed using the ASIA (American Spinal Injury Association) neurological chart. The results of this study help to evaluate the stabilization of the fracture, functional outcome of the procedure, neurological progress of posterior decompression, and also to identify any complications involved.

Materials and Method

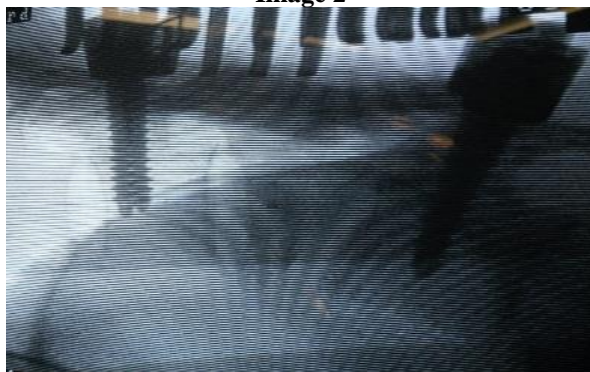
We conducted a non-randomized, cross-sectional study evaluating of 31 patients who underwent posterior decompression to manage their thoracolumbar fracture. The study population consisted of Indian patients of both genders, between 18-50 years of age, with a TLICS score ≥ 4 and associated neurologic deficit. Those with osteoporotic bone fractures as well as pathologic fractures were excluded from this study. An MRI scan of the thoracolumbar spine was done to determine the extent of the canal and nerve involvement. The operative procedure featured detaching the para-spinal musculature subperiosteally and exposing the junction of the lateral facet and the

transverse process. The pedicle screws were inserted at this junction. They were inserted one level above and one level below the affected vertebrae. Decompression by laminectomy was done at the fracture area. Contoured rods were applied and distracted on both sides and tightened with locking nuts. Cross links were placed for some patients. Image 1 and Image 2 shows the insertion of the pedicle screws. Image 2 shows its placement during the surgery.

Image 1



Image 2



Neurological charting as per the ASIA neurological chart (Annexure) as well as calculation of the Visual Analogue Score (VAS) was done to assess the functional outcome of the procedure. The radiological outcomes were determined using anteroposterior and lateral radiographs to measure the kyphotic angle. Patients were later followed up at 3 weeks, 6 weeks, 3 months, 6 months, and 12 months after surgery. All characteristics were summarized descriptively. For continuous variables, mean, and standard deviation (SD) were calculated. For categorical data, proportions and percentages were used to summarize the findings. Data was analyzed using SPSS software version.24.0. Paired t-test was applied where strong significance was defined as ($p < 0.01$), moderate significance was defined as ($0.01 < p < 0.05$), and suggestive significance was defined as ($0.05 < p < 0.10$).

Results

In total, there were 31 (19 male, 12 female) patients with mean age being 32.32 ± 9.25 years.

Majority of the patients were between the age of 21-30(38.71%) years with maximum incidence being the productive age group 19-40 years (80.65%). On inquiry of how the patient received the fracture, 17 patients allegedly sustained a fall from a height while 14 reported having been involved in a road traffic accident. L₁(35.48%) was the commonest level involved followed by T₁₂(32.26%), L₂(22.58%), T₁₁(9.68%). The most common fracture type was of burst morphology.

The TLICS score for all the patients was compiled and is shown in Table 1.

Table 1: Distribution of TLICS Score among the Participants

TLICS Score	Frequency	Percentage
4	4	12.9%
5	7	22.58%
6	11	35.48%
7	3	9.67%
8	2	6.45%
9	2	6.45%
10	2	6.45%
Total	31	100%

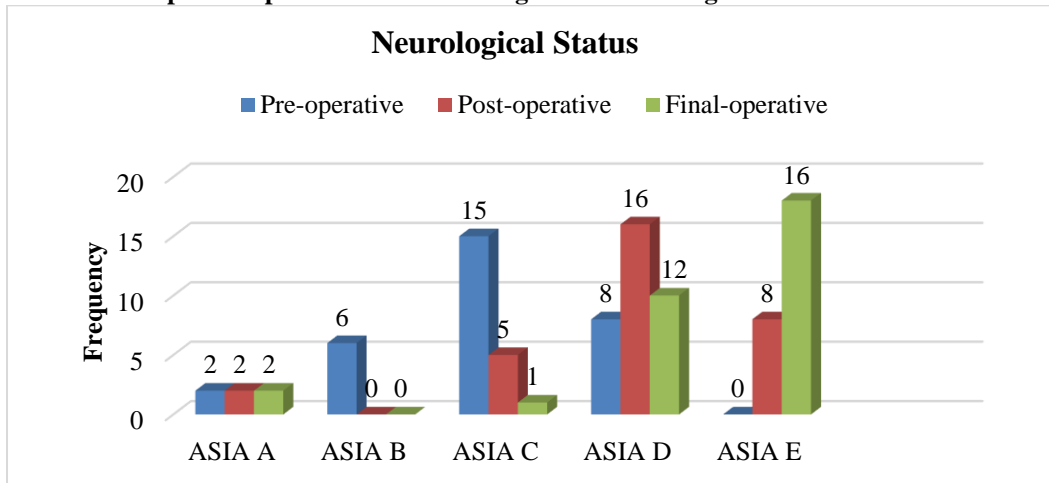
The average duration of hospital stay was 12.52 ± 2.06 days. The ASIA grading was done to assess neurological status in the preoperative and postoperative period (Graph 1). The postoperative neurological status remained unchanged in 3 patients of which 2 patients had complete cord injury prior to the surgery. The rest of the patients neurological status improved post operatively. The mean with the standard deviation for the ASIA Motor Score, Visual Analogue Score, and the Kyphotic Angle was calculated and is shown in Table 2.

Table 2: Pre-Operative and Post-Operative Changes Observed in Various Indexes

	Pre-operative	Post-operative
ASIA Motor Score	69.90 ± 12.51	84.23 ± 13.77
Visual Analogue Score	7.74 ± 0.66	5.03 ± 0.7
Kyphotic Angle	26.77 ± 3.67	13.03 ± 2.62

When the pre-operative and post-operative ASIA Motor Scores and Visual Analogue Scores were compared, the improvement was considered to be significant ($p < 0.001$) for both parameters. The Kyphotic Angle correction obtained was 16.33 degree, which is statistically significant ($p < 0.001$). Graph I. shows the variation between the Motor scores at different stages of management.

Graph 1: Improvement of Neurological Status Using ASIA Motor Score



The following X-Rays show the thoracolumbar fracture in one patient and its correction after surgery. Image 3 is a preoperative AP view X-ray. Image 4 is a preoperative lateral view X-ray. Image 5 is an immediate postoperative AP view X-ray. Image 6 is an immediate postoperative lateral view X-ray. Image 7 is an X-ray of a 2 year follow up in the AP view. Image 8 is an X-ray of a 2 year follow up in the lateral view.

Image 3



Image 4



Image 5



Image 6

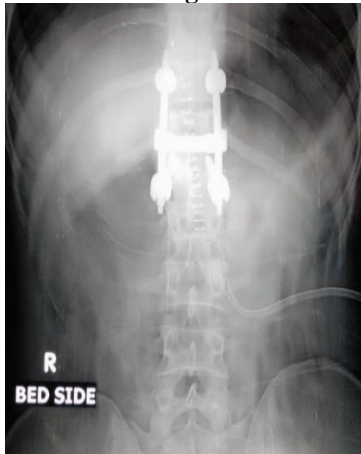


Image 7

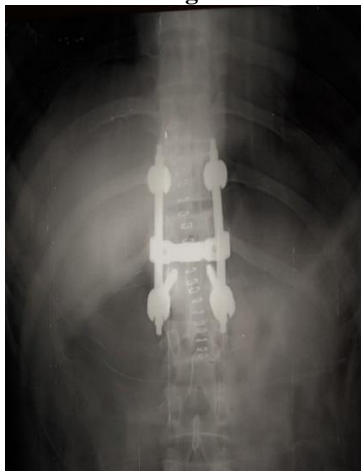


Image 8



treated by placing a free fat graft followed by and water tight closure of all the layers. Two patients developed bed sores and urinary tract infections. A superficial wound infection was seen in one patient which was treated by antibiotics.

Table 3: Comparison of Neurological improvement seen in various studies

Study	Neurological Improvement
Khare S et al ⁽¹³⁾	82.6%
Arora B et al ⁽¹⁶⁾	80%
Deng Z et al ⁽⁴⁾	84.9%
Dai LY et al ⁽⁸⁾	75%
Present study	90.3%

The following images show a patient who had come for a follow up one year post-surgery stretching in various positions indicating his comfort in performing different motions. Image 9 and 10 show the patient lifting his right and left lower limb respectively. Image 11 and 12 show the patient tilting to his right and left respectively. Image 13 shows the patient bending forward while keeping his knees unbent.

Image 9



Image 10



Implant failure was suspected if there was any increasing pain, progression of kyphosis or worsening of neurological status. Two patients had screw breakage with persistent back pain at the time of their last follow up without worsening of the neurological status. Five of the 31 patients developed complications. Two patients had an intraoperative dural tear. The dural tear was

Image 11**Image 12****Image 13**

Discussion

The treatment of thoracolumbar fractures remains challenging and debatable. It is generally recommended that patients with neurological involvement and unstable fractures require surgical intervention.^(1,4) Recent literature shows that optimal surgical and functional outcomes are possible with the posterior approach. Pedicle screw fixation via posterior approach has been widely used for most thoracolumbar fractures owing to its 3 column fixation and satisfactory clinical outcome. Short segment posterior fixation is frequently regarded as a valuable choice. Even though there are complications such as implant failure and loss of correction, this procedure is easier to perform and

allows more preservation of spinal motion segments.^(5,6,7) The necessity of fusion is still questionable as recent studies have shown that no significant difference has been reported between the fusion and non-fusion groups.^(4,8,9) TLICS classification system was used in this study. It is defined by Vaccaro et al, based on three injury characteristics which include morphology of injury, integrity of the posterior ligament complex and neurological status of the patient. This classification is useful in decision making in terms of the need for operative versus non operative management.⁽¹⁰⁾ In our clinical study, 31 patients were treated with posterior decompression and stabilization without fusion. Various observations made by other studies were also supported in this study. Observations such as male preponderance,^(11,12) L₁ fracture predominance,^(13,14) and commonest mode of injury^(11,12,15)—fall from height—were also found in the present study. The present study reported greater neurological improvement as compared to other studies. The difference in results is shown in Table 3. In this study neurological recovery was improved in 28 out of 31 patients (90.3%). Neurological status remained unchanged in 3 patients in which 2 patients had complete cord injury prior to the surgery. There was no case of neurological deterioration in this study.

In our study on comparing the mean preoperative (69.9±12.51), postoperative (84.23±13.77) and final follow up (90.58±13.55) ASIA motor score the improvement was highly significant (p<0.001).

Conclusion

Patients with unstable thoracolumbar fractures with neurological involvement with deformity were advised surgery. Short segment pedicle screw fixation through a posterior approach has emerged as the treatment of choice for such patients. Pedicle screws have a high pull-out, cut-out strength and can withstand high stress. In our study, there was marked improvement in the neurological outcome. To assess the radiological outcome, however, further studies must be done requiring long term follow-up. As this study has shown, stabilization of spine using posterior short segment transpedicular fixation with posterior decompression is safe, technically easy, and effective with significant neurological and functional improvement.

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