

# Clinicoradiological Outcome of Short Segment Fusion in Thoracolumbar Vertebral Fractures...A Study of 20 Cases

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**Abstract:** ***Study design:** Prospective consecutive series. **Objective:** To evaluate the efficacy of short segment instrumented fusion in thoracolumbar vertebral compression and burst fractures. **Summary of Background Data:** Traumatic thoracic and lumbar spine fractures have been managed by various options already described in literature beginning from non-operative to various surgical options. Still insufficient evidence is there in the literature regarding choosing the treatment option which would provide good outcome. Even though literature suggests pedicle screw fixation comparatively better option but controversy still exists in decision making of the vertebral segments to be spanned i.e. long segment or short segment fusion. **Methods:** A prospective clinicoradiological evaluation of 20 patients was done who had been diagnosed post traumatic vertebral fractures and were operated for the same with short segment posterior instrumented fusion. Fusion and stability was assessed clinically by subjective pain and neurological manifestation assessment using VAS, PROLO'S SCALE and BEAUJON SCORE. **Results:** We found in our study that short segment fusion had good efficacy for thoracolumbar fractures. It helps in correcting kyphosis (sagittal axis) and accomplishes fusion with minimal complications and post-operative morbidity. We successfully achieve solid fusion with good mechanical alignment in majority of the patients with very good functional status at a minimum of 1 year follow-up.*

**Keywords:** thoracolumbar fractures, pedicle screw fixation

## 1. Introduction

Unstable thoracolumbar fractures mainly occur due to traumatic injury to the spine with presence of both flexion and rotational force. These fractures are usually associated with a disruption of the posterior ligament complex and spinous processes separation. It may be associated with dislocation or slice fractures<sup>1</sup>. Considering these injuries unstable, operative management has been considered the first line of treatment for such fractures.

Pain, deformity, and neural injury are the key features seen in such injuries for which segmental instrumentation provides reconstruction and early mobilization. Short and long construct strategies for spine fixation have been described with either of them having various advantages and disadvantages.

The main indications of surgical intervention are compression fractures with more than fifty percent collapse or a sagittal angulation of more than 20 degrees, burst fractures with similar collapse and angulation as above or a three column involvement. Neurological involvement also has been considered for a surgical intervention mostly associated with burst fractures, fracture dislocations or a severe flexion distraction injury.

Kyphosis correction following a thoracic fracture can be achieved using posterior instrumentation by the mechanism of distraction<sup>3,4</sup> but similar distraction has been associated with loss of lumbar lordosis and neurological stretch injury in lumbar fractures. Though some studies suggest that loss of correction may be seen due to absence of anterior spinal column support.<sup>5,6,7</sup>

## 2. Materials and Methods

During a two year period, 20 patients were treated with short segment fixation for thoracolumbar vertebral fractures. Patients with traumatic T12 to L2 fractures were considered for operative management for restoration of sagittal balance. The indications for fixation were kyphosis > 20° and/or anterior body collapse > 50%<sup>8,9</sup>. Pre-operative neurological charting was done in all the patients, none of them had any pre-operative neurological deficits. Anteroposterior and lateral radiographs of the thoracolumbar spine was obtained. CT scan of the thoracolumbar spine was also done in all the cases<sup>10,11</sup>. The ratio of females to males was 1:3 with 5 female and 15 male patients. The mean age at the time of injury was 32.65 years. Time taken for surgery from the time of admission was 1.33 days. Mean duration of hospitalisation was 10.4 days.

Pedicle screws were inserted into the vertebrae above and below the level of the fracture, and fixed using connecting rods for producing distraction and slight lordosis.<sup>12,13,14</sup> No attempt was made at stabilization of the anterior column. None of the patients required decompression of the spinal canal. Post operatively all patients were mobilized with the help of a Knight-Taylor's brace. Edge of bed mobilization was started on the first post op day, followed by full weight bearing walking with the help of a walker from second post op day. Wound inspection and suture removal was done on the 14th post op day.

Patients were followed up regularly on the 14th post op day, 30th post op day, following which they were asked to review every 4 weeks. On each visit the patient's VAS, Prolo score and Beaujon score was assessed.<sup>15</sup> The final follow up visit was used as the outcome measures in this study. Mean

follow up was 18 months. None of the patient's underwent removal of implants.

### 3. Analysis

Cases which had undergone surgery were regularly followed up postoperatively for a minimum of 1 year to gather information regarding clinico-radiological outcome of the surgery. Fusion and stability was assessed clinically by subjective pain and neurological manifestation assessment using VAS and Beaujon scale<sup>15,16</sup>.

#### 3.1 VAS Scoring

VAS or visual analogue scale is a subjective scale to assess the amount of pain in an individual. Operationally a VAS is usually a horizontal line, 100 mm in length having values from 0 to 10. It can be divided for assessment from no to severe pain.

No to mild: 0-2  
 Moderate: 3-6  
 Severe: 7-9  
 Worst: 10

#### 3.2 Beaujon's Scale

Originally scale was given for spinal stenosis but we have used it to detect and compare the neurological status of the patient. It comprises of the below assessment points.

		1	2	3	4
Walking	< 100 m	100-500 m	> 500 m	No Limitation	
Rest sciatica	Continuous	Crisis	Moderate	None	
Effort sciatica	Continuous	Moderate	None		
Back Pain	Continuous	Crisis	Moderate	None	
Neurological status	Major deficit		Moderate		None
Medications	OMS 3	OMS 2	None		
Quality of life	Impossible			Normal	

**Figure 1: BEAUJON'S scale**

#### Interpretation of Score

- Max post op score can be 20
- $(\text{post-op score} - \text{pre-op score}) / 20 - \text{pre-op score}$
- Score is interpreted as follows
- > 70% gain: very good result
- 40 to 70% gain: good result
- 10 to 40% gain: poor result
- < 10% gain: failure

Functional outcome was assessed by using Prolo's scale. The maximum follow up scores were compared with the pre-operative scores.

#### 3.3 Prolo's Scale

To assess the functional outcome of the patients Prolo's scale was used. Prolo's scale include questions to assess functional and economic status.

Score	Criteria
<b>functional status</b>	
1	total incapacity
2	mild to moderate level of low-back pain &/or sciatica
3	low level of pain & able to do everything except sports
4	no pain, but has had >1 recurrence of low-back pain or sciatica
5	complete recovery w/o recurrent pain, no activity restriction
<b>economic status</b>	
1	complete disability
2	no gainful occupation but can do housework or some retirement activities
3	able to work but not at previous occupation
4	able to work at previous occupation but w/ restrictions or limited status
5	able to perform previous occupation w/o restrictions

**Figure 2: Prolo's scale**

#### Interpretation

Scores of functional and economic status are added and interpreted as follows

- >9 : excellent results
- 5-8: moderate
- <4: poor results

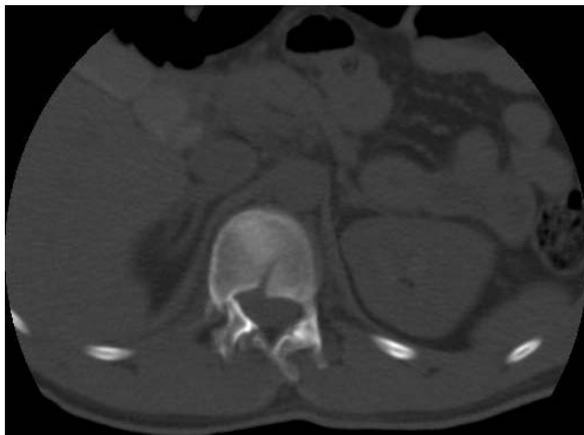
#### Fusion assessment

1. Absence of loosening of implants in both anteroposterior and lateral views will be an indirect evidence of fusion in short term follow up
2. Features of consolidation of graft
3. Presence of fusion in patients with more than 1 yr follow up

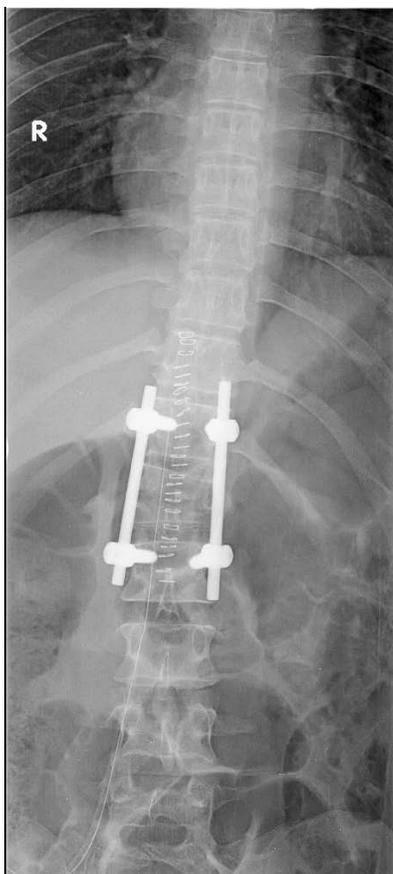
#### 4. Case Example



**Figure 3,4: pre-operative radiographs**



**Figure 5.6:** Pre-operative CT scan



**Figure 6,7:** post operative radiographs

## 5. Observations

### Sex predilection

Among 20 patients, 15 were males and 5 were females

### Age

Majority of patients in our study were among the age group of 20 to 45 years with mean age of 32.65 years.

### VAS score

Out of 20 patients, preoperatively 19 patients had severe pain which reduced to moderate in 4 patients, absence of pain in 3 patients and 13 patients having mild pain. This shows that 80% of the patients had significant improvement in pain.

### Beaujon's score

It showed very good results in 4 patients and good results in 15 patients suggesting that 95% of the patients had significant improvement in the functional status post surgery.

### Prolo's scale

Functional outcome was also correlated pre-operative to postoperatively by prolo's score which showed moderate to excellent outcome in 95% of patients.

Sl No.	Age/Sex	Vertebral fracture	Pre Op prolo's	Pre Op VAS	Post Op VAS	Post Op Beaujon	Post Op Prolo score	Follow up
1	27/F	T12	poor	severe	mild	good	exc	1yr
2	29/M	L5	poor	severe	mod	good	mod	2yr
3	23/M	L1	poor	severe	mild	V. good	exc	1yr6mon
4	36/M	L1	poor	severe	no	v. good	exc	1yr8mon
5	45/M	L4	mod	severe	no	v.good	exc	1yr2mon
6	60/M	L2	poor	severe	mod	poor	poor	1yr
7	30/F	L1	poor	severe	mild	good	mod	2yr
8	21/F	L3	mod	severe	mild	good	mod	2yr
9	22/M	T4,T5,T6	poor	severe	mild	good	mod	3yr
10	26/M	T10	poor	severe	mild	good	mod	1yr
11	21/M	L1	mod	mod	no	v.good	exc	1yr4mon
12	40/M	T12	poor	severe	mild	good	mod	1yr
13	38/F	L2	poor	severe	mild	good	mod	1yr6mo
14	42/M	L1	poor	severe	mild	good	mod	1yr5mon
15	36/M	T10,T11	poor	severe	mild	good	mod	1yr7mon
16	21/M	L1	poor	severe	mild	good	mod	1yr
17	29/M	L1	poor	severe	mild	good	mod	1yr10mon
18	39/M	T11	poor	severe	mod	good	mod	1yr
19	23/M	L2	poor	severe	mod	good	mod	2yr
20	45/F	T12	poor	severe	mild	good	mod	1yr

\*all scores are at the maximum follow up period

## 6. Discussion

Operative treatment has several advantages over bed rest and immobilization<sup>17</sup>. Immediate spinal stabilization is achieved in patients who cannot tolerate bed rest and immobilization. In the multiply injured patient, prolonged bed rest predisposes to severe and life threatening complications like bed sores, sepsis, aspiration and lower respiratory tract infections. Surgical stabilization also allows the patient to sit upright, transfer to a wheelchair, and start rehabilitation earlier, with fewer complications<sup>18</sup>. Surgical treatment more reliably restores sagittal alignment, translational deformities, and canal dimensions than bed rest and immobilization<sup>19</sup>. Finally, even though there is insufficient evidence to prove the point, some clinical studies have suggested that surgical decompression more reliably restores neurologic function<sup>15,16</sup>. Short-segment pedicle instrumentation is the most widely practiced approach now used for thoracolumbar and lumbar fractures around the world<sup>19</sup>.

Short segment instrumentation works by a cantilever mechanism and depends on integrity of the anterior column in order to maintain sagittal balance<sup>17</sup>. Short-Segment Pedicle Screw Instrumentation (SSPI) direct reduction of sagittal deformity and translation while immobilizing the shortest possible segment of the lumbar spine, thereby minimising adjacent level degeneration.<sup>20</sup> Recent studies have shown anatomic reduction can be obtained by specific manipulation of the pedicle screw constructs can lead to better stability. The pedicle screw construct provides three-column fixation to the vertebral body, allowing for simultaneous corrective forces to be applied in axial compression or distraction, flexion or extension, and in rotational, coronal, and sagittal translation. Oda and Panjabi returned a thoracolumbar burst fracture to optimal anatomic alignment by a combination of distraction and hyperextension manoeuvres, pure compression forces tended to result in greatest stability.<sup>21</sup> Injudicious over distraction during fracture reduction can displace bony elements, causing serious neurologic injury. Late collapse

and fatigue failure can occur during posterior reconstruction of severe burst fractures, without restoring the anterior weight-bearing column due to excessive cantilever bending forces<sup>21</sup>. Restoration of thoracolumbar lordosis at the time of surgery is essential, or the forces of weight-bearing fall anterior to the lumbar spine and pelvis, imparting an exaggerated flexion moment to the construct and predisposing it to implant failure. Technique and construct design cannot alter the damage done to the spinal cord at injury, either, and functional outcomes are most profoundly dependent on neurologic integrity.

## 7. Complications

None of the patients had any superficial or deep wound infections. There were no neurological complications related to surgery, or in pedicle screw placement. None of the patients required re-surgery. One patient complained of persistent radicular pain because of multiple degenerative disc disease associated with the fracture giving poor outcome after surgery.

## 8. Conclusion

At review all patients had a minimum follow up of 1 year with a mean follow up of 1.5 years. The Cobb angle, percentage loss of anterior body height and percentage loss of midsagittal canal diameter, at injury, post-fixation and at review were assessed. This was correlated against VAS, Prolo's score and Beaujon score. We found in our study that short segment fusion had good efficacy for thoracolumbar fractures. It helps in correcting kyphosis (sagittal axis) and accomplishes fusion with minimal complications and post-operative morbidity. We successfully achieve solid fusion with good mechanical alignment in majority of the patients with very good functional status at a minimum of 1 year follow-up.

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