

Radiological and Functional Outcome of Short Segment Posterior Stabilization with Intermediate Pedicle Screw in Single Level Thoracolumbar Burst Fractures: A Prospective Study

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Abstract: *Background:* Thoracolumbar junction (D11-L2) is very prone for injury because of its location between rigid kyphotic thoracic spine and mobile lordotic lumbar spine. *Method:* 35 patients treated with short segment pedicle screw fixation with intermediate screw. Clinical (oswestry disability index) and radiological (local kyphotic angle and beck's index) parameters were used. *Results:* Most of our patients were male (28 male), 7 female (25.71%). Most common involved level L1 (80%) and D12 (25%). Mean preop ODI is 92.037 which decreased to 28.673. Mean preop local kyphotic angle is 15.028° which was corrected to 4.057° with correction loss of 0.657° at final follow-up. Mean preop beck's index was 0.543 which was corrected to was 0.864 with correction loss of 0.024 at final follow-up. *Conclusion:* Reinforcement with intermediate screw for a single thoracolumbar burst fracture enhanced the stability. It was facilitative to correction of kyphosis with maintenance of the reduction effects with improved functional outcome. Nevertheless, long term studies are needed to support the outcomes.

Keywords: thoracolumbar spine, short segment pedicle screw, intermediate pedicle screw, local Kyphotic angle, beck's ratio, ODI.

1. Introduction

In today's world, spine fractures are leading problem. Changing life style of the individuals making them prone for the injury. Anatomically and functionally, the thoracic and lumbar spine can be divided into three regions – thoracic spine (T1-T10), thoracolumbar junction (T10-L2) and the lumbar spine (L3-L5)¹. These fractures are typically caused by high-velocity accidents, such as road traffic accidents (RTA) or fall from height. Among these 50-60% affected the transitional zone (T11-L2), 25-40% affected the thoracic spine and 10-14% involved the lower lumbar spine and sacrum. Thoracolumbar fractures are more frequent in men and the peak incidence is observed between 20-40 years.² Neurological injury complicates 20-36% of fractures at the thoracolumbar junction^{3, 4, 5, 6}. The thoracolumbar junction comprises from T11 to L2. Due to most mobile segment, it is more prone for injury. The following anatomical reasons make the thoracolumbar transition susceptible to injury.

- 1) Transition from a rigid thoracic kyphosis to a mobile lumbar lordosis at the level of T11 to L2.
- 2) Lesser stability to the thoracolumbar junction due to floating eleventh and twelfth ribs.
- 3) Facet joints orientation in coronal plane at thoracic region. This limits flexion and extension while providing substantial resistance to antero-posterior translation. The facet joints orientation in sagittal plane at lumbosacral region. This limits rotation and lateral bending with increasing orientation flexion and extension.

Treatment goals for thoracolumbar burst fractures include restoration of spinal stability and alignment, correction of kyphotic deformity and decompression of the spinal canal.^{7, 8, 9} Internal fixation and stabilization has the advantage of early mobilization and protects the neurological structures from further injury and enhance their recovery¹⁰. Pedicle

screw is passed through the force nucleus of the vertebra¹¹. Long segment instrumentation has been largely replaced by short segment fixation. This decreases the number of mobile segments sacrificed in the fusion^{12, 13}. Short segment instrumentation using intermediate screw includes insertion of an additional pedicle screw at the level of the fractured vertebra. Theoretically this will improve the biomechanical stability of the construct. It will also share load and will provide stronger construct¹⁴.

Aim and Objective

Aim

To assess the radiological and functional outcome of patients having thoracolumbar spine fractures in > 18 year age treated with short segment pedicle screw fixation with intermediate pedicle screw at the fracture level.

Objectives

- To determine the radiological outcome in terms of correction and maintenance in mean local kyphotic angle and beck's ratio.
- To determine the functional outcome as per Oswestry Disability Index (ODI).

2. Materials and Methods

This Prospective observational and interventional study assesses the radiological and functional outcome of short segment posterior stabilization with intermediate screw at fracture level in thoracolumbar spine fractures. This study was conducted on patients with thoracolumbar spine fractures, who were treated with short segment posterior stabilization with intermediate screw at fracture level at Department of Orthopedics at Dr. S. N. Medical College Associated Hospital, Jodhpur from June 2017 to November 2019.

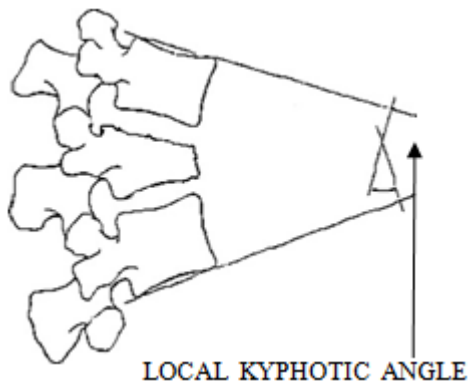
Inclusion Criteria : Patients aged >18 years of both gender having post traumatic thoracolumbar spine fracture with atleast one intact pedicle in fractured vertebrae in along with additional features as below:

- From D11-L2 vertebral fractures.
- Vertebral body height >50% loss.
- AO spine classification Type A3, A4, B2.
- No/minor associated injuries.

Exclusion Criteria: All patients with the following will be excluded:

- Multilevel spinal injuries.
- Patient not fit for surgery.
- Patient unable to cooperate in post-operative rehabilitation because of psychosis, mental retardation, head injuries or CVA.
- Patient with associated injuries.
- Pathological vertebral fractures.

In all patients, Local Kyphotic angle¹⁵ and Beck's ratio¹⁶ (anterior height / posterior height of fractured vertebrae) was measured preoperatively, postoperatively and on each follow up by lateral radiograph and mean change in local Kyphotic angle and Beck's ratio assessed.



Oswestry disability questionnaire¹⁷ will be filled pre and post operatively and on each follow up and functional outcome was assessed by Oswestry disability index . Mean change in Oswestry disability index was assessed.

Surgical Approach and Technique

After Proper Positioning midline posterior approach used. Entry points of pedicle screws made with the help of

trochar. Blunt kirschner's wires inserted through the pedicles and their position is confirmed fluoroscopically. Pedicles are Probed and taped. Appropriate length screw inserted. Appropriate size rod is selected and contoured. Reduction achieved by distraction technique (Ligamentotaxis) and confirmed using a C-arm. Reduction steps are: correction of kyphosis, lordotic distraction for further reduction of vertebral height and intra-canal fragment, and final tightening. Thorough irrigation done with normal saline, drain inserted, and the wound is closed in layers.

Post operative protocol

Post operative intravenous antibiotics for 5 days. First wound inspection done on 3rd postoperative day and looked for any discharges, blister, gaping. Drain removed after 48 hrs or when 24 hr drain output < 50cc followed by check X-ray. Advised 2 hourly regular turning to prevent bed sore. Stich removed on 14th post operative day. Patients were allowed to sit and walk with thoracolumbar brace. Walking with support after 6 weeks depending upon neurologic status of the patient.

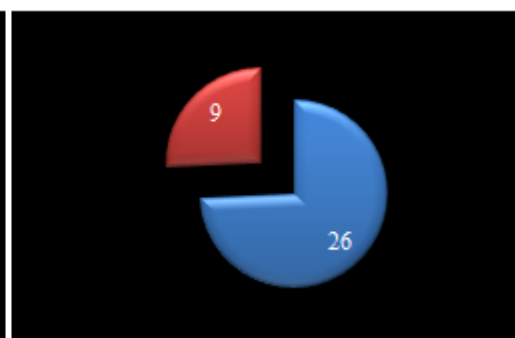
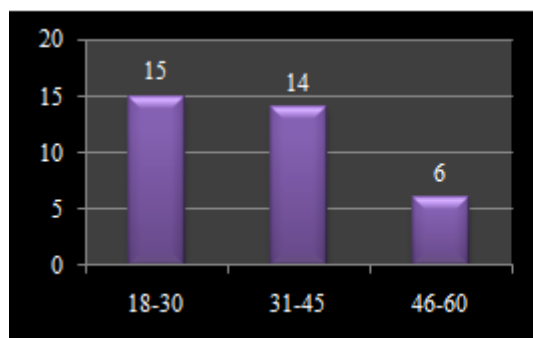
Follow up

Patient followed up on 6th week, 12th week, 6th month, 9th month, 1 year post operatively and at every follow up data was recorded on the Proforma and ODI questionnaire will be filled on every follow up with measurement of local kyphotic angle and beck's ratio from lateral radiograph.

3. Observation & Results

The present study includes 35 cases of thoracolumbar junction fractures, treated in department of orthopedics at Dr S N Medical College and associated hospitals, Jodhpur. All patients were followed up for a minimum of 12 months. In present study thoracolumbar spine fractures was predominantly seen in male patients with 18-45 age with most common mode of injury was fall from height. 15 patients (42.86%) patients were in 18-30 yr of age and 14 patients (40%) were in 31-45 age and 6 patients (17.14%) were 46-60 age. Minimum age of patient was 18 years and maximum age of patients was 60 years. Mean age is 34.11 yrs in present study.

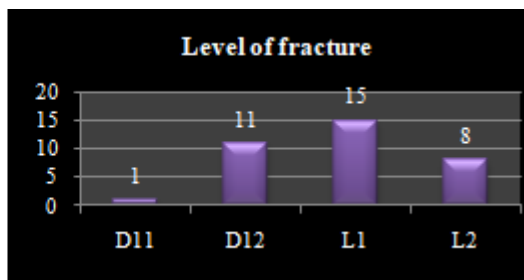
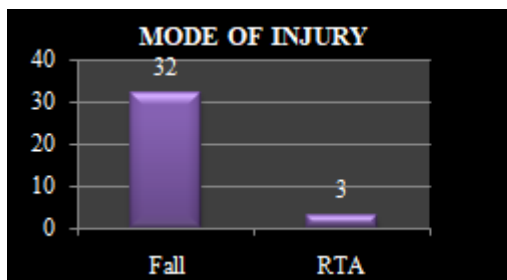
26 male patients (74.29%) and only 9 female (25.71%) were affected with these fractures in our study.



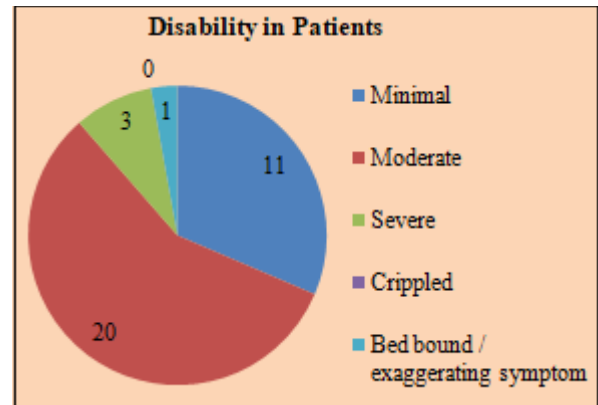
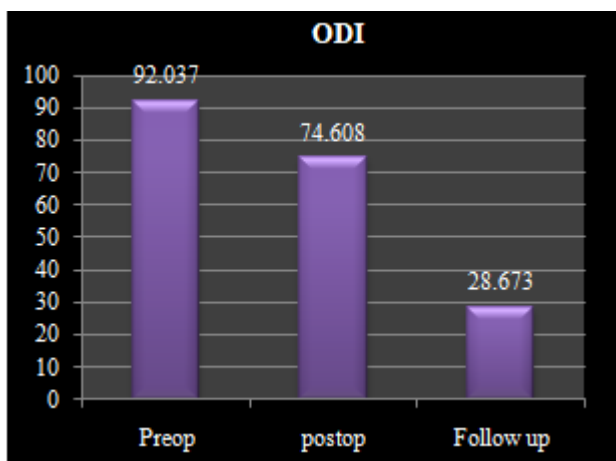
32 patients had history of fall from height and 3 patients had history of road traffic accident.

In present study most of patients, 15 patients (42.85%) were fractured at L1 vertebra. 11 patients (31.42%) were with D12 fracture which was 2nd commonly affected level of

fracture. 8 patients (22.85%) were had fracture at L2 level and 1 patient (2.85%) had fracture at D11 level.

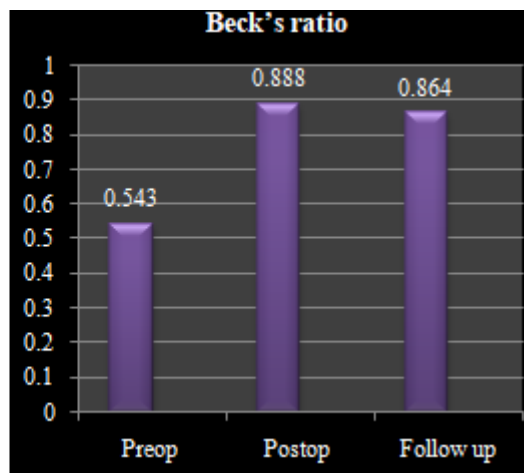
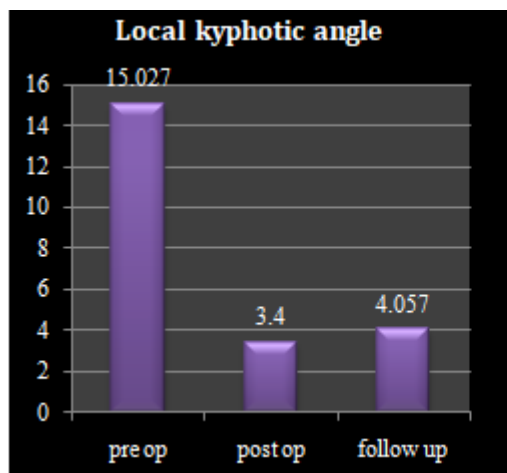


We use ODI questionnaire to assess the functional outcome and calculate ODI index. In present study mean preoperative ODI is 92.037 which reduced to 28.673 at latest follow up.



In present study at latest follow up 11 patients (31.43%) were with minimal disability, 20 patients (57.14%) were with moderate disability, 3 patients (8.57%) were with severe disability and 1 patient (2.86%) was with bed ridden or exaggerating symptoms. No patient was with crippled disability at last follow up.

Radiological outcome is assessed by local kyphotic angle and beck's index in present study. In present study mean preoperative local kyphotic angle was 15.028° which was corrected to 3.4° and at latest follow up mean local kyphotic angle was 4.057°. Loss of correction in local Kyphotic angle was 0.657°. In present study mean preoperative beck's ratio was 0.543 which was corrected to 0.888 and at latest follow up mean beck's ratio was 0.864. Loss of correction in beck's ratio was 0.024.



In present study 4 patients (5.71%) were associated with distal radius fracture and manage conservatively. In present study 2 patients (5.71%) had bed sores postoperatively and managed with regular dressing and every 2 hourly side turning advice. 2 patients (5.71%) were showed implant

prominence, this was due to these thin built and 2 patients (5.71%) were got surgical site infections which was managed conservatively with regular dressing and antibiotics according to culture sensitivity.

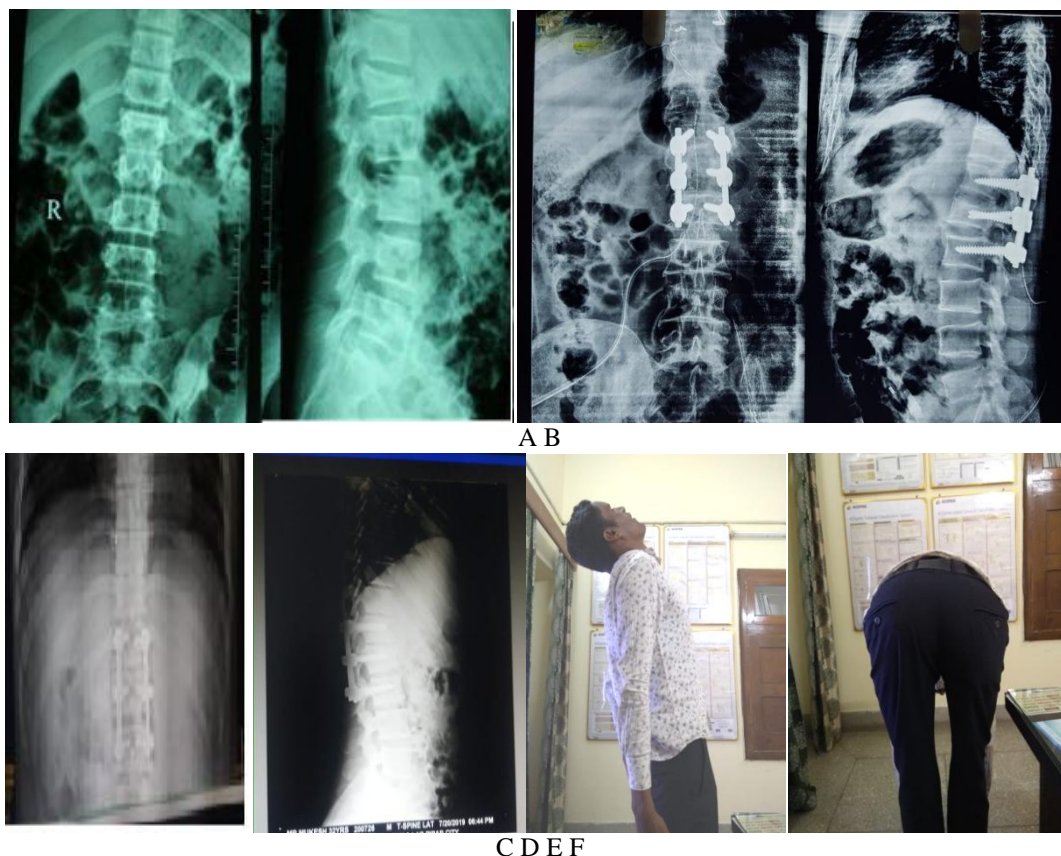


Figure A: AP and Lat view (preop), B. AP and Lat view (postop) C. AP view (14 month), D. Lat view (14 month), E. Clinical picture (14 month), F. Clinical picture (14 month)

4. Discussion

The present study conducted on 35 cases of thoracolumbar fractures admitted in the department of orthopedics at Dr S. N. Medical College, Jodhpur to assess the correction and maintenance in local kyphotic angle and vertebral height, with assessment of disability. Majority of patients were male (74.28%), aged from 18 -60 year with mean age 34.11 year, mostly involving L1 (42.85%) and D12 (31.42%) vertebral level with history of fall from height (91.42%). The mean local kyphotic angle was 4.057° at latest follow up with 0.657° correction loss. The mean Beck's ratio was 0.864 at latest follow up with 0.024 correction loss. The mean ODI was 28.673 at latest follow up which suggested mostly patients were with moderate disability at latest follow up. In present study the mean age of patients with thoracolumbar fractures were 34.11 years which is comparable with studies done by RKI Ragab et al¹⁸ and Farrokhi et al¹⁹, they had mean age of 37.2 years and 34 years respectively. In present study there was male predominance, that is 74.29%, which was Comparable with studies done by Tian et al¹⁴ and Farrokhi et al, they found male predominance of 70.4% and 72.5% respectively. In present study fall from height (91.42%) was the most common mode of injury which was comparable with studies done by Tian et al, Farrokhi et al, Jonathan-James et al²⁰. They found fall from height as a mode of injury that i.e. 59.3%, 60%, 64% respectively. The most common levels of fractured vertebra in present study are L1 (42.85%) followed by D12 (31.42%). This was comparable with Tian et al, Farrokhi et al. They had 40.8 %, 57.9% for L1 and 22.2%, 34.2% for D12 respectively.

The outcome analysis is based on both functional and radiological parameters. The Functional outcome was assessed by Oswestry Disability Index (ODI) and Radiological outcome was assessed by local Kyphotic angle and Beck's ratio.

The mean ODI at latest follow up was 28.673, which comes under moderate disability and comparable to Azimi P et al²¹ and Ahmed M et al²². They had mean ODI of 24.9 and 34.66 respectively at latest follow up.

Local kyphotic angle, measured in present study was 4.06° with mean correction loss of 0.657° at latest follow up, which was comparable with Yung & Thng et al²³, Kim et al²⁴ and Huang & Luo et al²⁵, they had local kyphotic angle of 3.68° , 8.2° and 2.51° respectively. These studies used conventional short segment stabilization without intermediate screw. None of the patients developed Kyphotic collapse in the follow up of present study.

The following table compares present study with other studies who also used intermediate screw. That shows the late collapse and kyphosis are very low when the intermediate screws are used.

	Preop	Postop	Followup
Hwang et al ²⁶	20.8 ± 6.4	8.2 ± 4.8	15.2 ± 6
Sapkas et al ²⁷	17	5	8.5
Huang & Luo et al	9.07 ± 1.87	3.26 ± 1.91	5.12 ± 1.07
Our study	15.04 ± 3.51	3.4 ± 2.45	4.06 ± 2.52

Beck's ratio is also maintained at latest follow up. This

signifies no collapse occurred in the vertebral body and Anterior and posterior vertebral heights were maintained. In present study mean Beck's ratio was 0.864 with loss of correction of 0.024. This is comparable with Yung & thng et al, which had Beck's ratio of 0.790 with loss of correction of 0.002 at latest follow up.

Complications are minimal in our study. 2 patients (5.71%) had bed sore, 2 patients (5.71%) had implant prominence and 2 patients (5.71%) had surgical site infection.

5. Limitation

This study included small no of patients and short term follow up. Findings may not be indicative of long term conditions, particularly after removal of implants. Further studies with more patients with longer follow-up needed to assess the efficacy of this technique.

6. Conclusion

We conclude that Short segment posterior stabilization with intermediate screws provide biomechanically stronger construct which corrects kyphosis and restores the vertebral body height and provides better outcome by maintaining kyphotic correction and vertebral height especially in fractures involving the thoracolumbar junction. Hence addition of pedicle screws in the fractured vertebra in short segment posterior stabilization is more compelling. However long term follow-ups with large no of patients were needed to further validate our findings.

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