

Original Research Article

Comparative Study of Radioclinical Outcomes of Short-Segment Pedicle Fixation Versus Long-Segment Pedicle Screw Fixation In Unstable Thoracolumbar Burst FractureDharmpal Bhatia¹, Prangal Agrawal², Manpreet Singh³, Navendu Ranjan⁴¹Senior Resident, Department of Orthopaedics, AIIMS Bhopal, Madhya Pradesh, India²Junior Resident, Department of Orthopaedics, SMS Medical college, Jaipur, Rajasthan, India³Senior Resident, Department of Orthopaedics, RUHS Medical College, Jaipur, Rajasthan, India⁴Senior Resident, Department of Orthopaedics, Dr. S.N. Medical College, Jodhpur, Rajasthan, India

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Abstract**Background:** This study is to compare the traditional long segment fixation and the short segment fixation analyzing the correction of deformity, maintenance of the correction, functional and neurological outcomes and prevention of fixation failure in thoracolumbar burst fracture.**Methods:** This study was conducted in 50 consecutive cases of short segment fixation and long segment fixation and comparison by using ASIA impairment scale, Cobb's angle, anterior vertebral body height (AVBH), Posterior vertebral body height (PVBH), and ratio of AVBH and PVBH.**Results:** Functional and neurological outcomes on basis of ASIA scoring and outcome in our study was similar in both group. Long segment instrumentation prolonged the operative time and increased the amount of blood loss significantly as compare to short segment fixation. Less loss of kyphosis correction was noticed in long segment as compare to short segment in thoracolumbar burst fracture. Comparison of anterior vertebral body height, posterior vertebral body and ratio of AVBH/PVBH between short and long segment was statistically not significant.**Conclusion:** Study comparing short segment versus long segment fixation in thoracolumbar burst fractures, demonstrated that long segment instrumentation is an effective way to correction of local kyphosis in thoracolumbar burst fractures.**Keywords:** Anterior vertebral body height, posterior vertebral body height and ratio of AVBH/PVBH.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Thoracolumbar fracture is one of the most common areas of fracture in the axial skeleton. For treating cases with neurological injuries, posterior screw fixation has been widely accepted. However, the proper management of thoracolumbar burst fractures (TBFs) in the absence of a neurological deficit remains controversial.¹⁻³ Some scholars advocate early surgical treatment even for mild TBFs because of a certain degree of spinal deformity, low back pain occurring over time.⁴⁻⁶ The management has undergone tremendous advances over the past three decades and includes a variety of surgical stabilization strategies.³ Treatment goals for thoracolumbar burst fractures include restoration of spinal stability and alignment, correction of kyphotic deformity and decompression of the spinal canal. Several surgical techniques are available for the treatment of thoracolumbar fractures: posterior, anterior, open, minimally invasive, and combined posterior-anterior ones. The ideal treatment for thoracolumbar burst fractures is controversial regarding the use of short or long posterior fixation constructs.⁷⁻⁹ Traditional methods of stabilizing the injured spine included the instrumentation of least two vertebrae above and two vertebrae below the fracture in order to provide good stabilization minimizing the risks of post traumatic kyphosis and implant breakage. Short-segment instrumentation with pedicle screws and rods (inclusion of one level above and one level below the fractured vertebra) grants the less blood loss and reduction of surgical time and preserve segments of motion at the lumbar spine.

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Materials and Methods

Hospital based Prospective Randomized comparative interventional study between two group short segment pedicle and long segment pedicle screw fixation. Patients with acute, traumatic fractures of the thoracolumbar junction (T11-L2). Sample size was calculated to be 25 subjects in each group and 6 month follow up in each group.

Evaluation and management of the patient bring at the scene of the injury, and proper transport of the patient is very important. Total spine immobilization is recommended for all patient with spinal injury. A hard cervical collar brace beside the head and an appropriate size spine board is used. First of all CABs (circulation, airway, breathing) done as protocol of Advanced trauma life support (ATLS) protocol. Neurological and Orthopedic examination and history should be obtained.

Symptoms

1. Severe back pain
2. Radicular pain

Results

The present study Comparative study of radio-clinical outcomes of short-segment pedicle fixation versus long-segment pedicle screw fixation in unstable thoracolumbar burst fracture was conducted in Department of Orthopaedics, S.M.S. Medical College and attached group of hospitals, Jaipur, Rajasthan. This study was conducted in 50 consecutive cases of short segment fixation and long segment fixation

The age range of the patients in short segment group was 17-50 years. The age range in long segment group was also 17- 50 years. The mean age was 34.4 ± 7.84 for short segment group and 36.24 ± 7.40 for long segment Group (LSF) respectively with no significant difference ($p = 0.942$). In our study in short segment group total 19 male (76%) and 6 female (24%) and in long segment group total no of

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22 male (88%) and 3 female (12%).

Our study comprised of total 82% male and 18% female in both groups. The male:female ratio was 4:1. Both groups were similar with regard to age and sex.

In our study among 50 patients, highest number is seen in the age between 31-40 years(50%) ,followed by 41 -50 years 24% , between 21- 30 years 20% and below 20 years 6 % . The two most common mode of injury in our long segment due to RTA (44%) and fall from height (56%) and in short segment was 40% due to fall from height and 60% due to RTA.

Thoraco lumbar fractures between T11 and L2 were included in this study. D11,D12 L1, and L2 fracture was sustained by 4% ,48%, 28%

and 20% respectively of the patients in the short segment group and D11,D12 L1, and L2 fracture 8 %, 28%, 44%, and 20 % respectively in the long segment group.

Functional and neurological assessment = In Group 1 Short segment pre operative, based on the ASIA scale, at admission 8 patients (32%) had (ASIA A), 5 patient (20%) had ASIA C, 12 patients (48%) and post operative Follow-up neurological status was assessed as following: ASIA D (4 patients: 16%), ASIA E (21 patients: 84%) . In long segment group preoperative group 6 patient (24%) ASIA A , 7 patient (28%) ASIA C,12 patient (48%) ASIA D and post operative follow up, 2 patients (8%) had ASIA D 23 patient (92%) ASIA E, Statistical analysis showed no difference between the two groups

1. Preoperative and postoperative neurological status American Spinal Injury Association (ASIA) scores for groups 1 and 2.

Score	Short Segment					Long Segment					P
	A	B	C	D	E	A	B	C	D	E	
Pre operative	8 (32%)	0	5 (20%)	12 (48%)	0	6 (24%)	0	7 (28%)	12 (48%)	0	0.05
Post operative	0	0	0	4 (16%)	21 (84%)	0	0	0	2 (8%)	23 (92%)	

Long segment instrumentation prolonged the operative time and increased the amount of blood loss significantly. Similar results are found by Tezereen and Kuru⁴ (2005)¹⁴ and Tarek Ahmed Aly⁹ (2017) in their study comparing short segment versus long segment fixation in thoracolumbar burst fractures. In our studies surgical time significant reduced in the SS group as compare to long segment . in short segment surgical time is 2.43 +_ 0.49 hour and in long segment that is 3.58± 0.49 hour.

Radiological results =

a) Local kyphosis angle

The difference was not significant between the two groups in preoperative results. The degree of loss of correction was calculated by subtracting the kyphotic angle at the last follow up from the immediate postoperative kyphotic angle, and this ranged from 4 to 6 in long segment fixation there was less loss of correction and in long segment fixation as compare to short segment correction that was 7 to 9.

During the study measure preoperative kyphotic angle, postoperative kyphotic angle (immediate), postoperative kyphotic angle (last follow up),

We calculated the amount of initial kyphosis correction as follows:

Percentage of kyphosis correction = Amount of correction (degrees)/Initial Kyphosis Angle x 100.

Percentage of loss kyphosis correction in long segment was = 4.57/8.80=51.93%

Percentage of loss kyphosis correction in short segment was = 7.21/8.92 = 80.82%

Less loss of kyphosis correction was noticed in long segment as compare to short segment in thoracolumbar burst fracture. In our study pre operative local kyphosis mean angle in long segment fixation was 21.12±1.44, immediate post operative mean angle was 8.8±1.15 and in last follow up after 6 month of surgery mean angle was 13.37± 1.25. while in short segment pre operative local kyphosis mean angle was 21.21± 1.55, immediate post operative mean angle was 8.92±1.15 and in last follow up after 6 month was 16.13±1.42. Local kyphotic angle less loss of correction observed in long segment fixation as compare to short segment and that is statistically significant.(P value=0.002)

2. Mean Local Kyphotic angle (in degree)

Local Kyphosis angle	Long-segment group	Short-segment group	p
Pre operative	21.12± 1.44	21.21±1.55	0.002
Immediate postoperative	8.8±1.15	8.92±1.15	
6 months postoperatively	13.37±1.25	16.13±1.42	
Percentage of loss kyphosis correction	51.93%	80.82%	

b) The anterior vertebral height in short segment was 16.99 ± 1.43 mm, preoperative, 17.78 ± 1.46mm immediate postoperative, and 21.19 ± 1.39mm at the last follow-up of short segment and in long segment anterior vertebral body height was 17.16 ± 1.34mm preoperative, 17.68 ± 1.10 mm at immediate postoperative, and 22.94 ± 1.15 at last follow-up . These results are less loss of anterior vertebral body height in long segment as compare to short segment but that was statistically not significant (P value=2.16).

c) The posterior vertebral height was 24.43 ± 0.60 mm preoperative, 24.59 ± 0.58 mm at immediate post operative, and 24.92 ± 0.43 mm at last the follow-up in short segment fixation and in long segment posterior vertebral body height was 24.23 ± 0.71 mm preoperative, 24.53± 0.62 mm at immediate postoperative, and 24.88± 0.49 at the

last follow up. These results were not statistically significant for either of the groups (P value=0.31)

d) Ratio of ABH/PBH=Changes of the ABH/PBH ratio, which reflect the fracture induced wedge shape of the vertebral body. The average ABH/PBH ratio in short segment was 69.5 preoperative, 72.3 at immediate postoperative, and 85.0 at last follow-up , while it was 70.8 preoperative, 72.1 at immediate postoperative, and 92.2 at last follow up. The results show the absent of statistical significant differences (P value=0.07) between these two group in terms of restoration of fractured vertebral body shape and maintenance of the restoration over the time . Surgery resulted in an almost complete reconstruction of the original shape of the vertebral body in long segment as well as in short segment.

3. Distribution of cases according to Ratio of Anterior Vertebral body height/ Posterior vertebral body height

Ratio of Anterior Vertebral body height/Posterior vertebral body height	Short Segment group	Long Segment group	p value
Pre operative	69.5	70.8	
Immediate postoperative time	72.3	72.1	
6 months postoperatively	85.0	92.2	0.07

Tezeren and Kuru¹⁴ (2012) ,their study comparing short segment versus long segment fixation in thoracolumbar burst fractures, demonstrated that long segment instrumentation is an effective way to manage thoracolumbar burst fractures. Short segment pedicle instrumentation had a high rate of failure.

Altay et al¹⁵ (2007) reported that use of four pairs of screws (two above and two below) to lengthen the level arm of the construct would probably not only enhance the stability but also allow effective reduction of kyphotic deformity.

Peters et al¹⁶ (2014), in their bio-mechanical study comparing short segment versus long segment fixation, found that long posterior fixation was the stiffest with and without anterior column augmentation in all loading

Conditions. The use of screws two above and two below has shown to not only enhance the stability but also allow effective reduction of kyphotic deformity .

Carlos et al¹⁷ (2016),also reported that segmental transpedicular fixation two levels above the kyphosis should be used at the thoracolumbar junction where compressive forces act more anteriorly. There is no significant difference in term of infection and any implant failure in short segment and long segment group.

Discussion

Comparison of short segment and long segment fixation on basis of neurological outcome ASIA scoring and radiological outcome cobb angle and anterior vertebral body height , posterior vertebral body height and ratio of anterior body height and posterior body height. Functional and neurological outcomes on basis of ASIA scoring. The neurological outcome in our study was similar in both group. There was no difference between the Short segment and Long segment fixation.

Long segment instrumentation prolonged the operative time and increased the amount of blood loss significantly as compare to short segment fixation.

There is no significant difference in term of infection and any implant failure in short segment and long segment group.

Measurement of local kyphosis angle in short and long segment fixation immediate postoperative and at end of last follow up and outcome was Less loss of kyphosis correction was noticed in long segment as compare to short segment in thoracolumbar burst fracture. Local kyphotic angle less loss of correction observed in long segment fixation as compare to short segment and that is statistically significant.

Comparison of anterior vertebral body height between short and long segment. These results are less loss of anterior vertebral body height in long segment as compare to short segment but that was statistically not significant .Changes of the ABH/PBH ratio, which reflect the fracture induced wedge shape of the vertebral body The results show the absent of statistical significant differences between these two group in terms of restoration of fractured vertebral body shape and maintenance of the restoration over the time. Surgery resulted in an almost complete reconstruction of the original shape of the vertebral body in long segment as well as in short segment in short segment technique allowed to save two or more segments of vertebral motion, operative time and blood loss as compared to long segment fixation.

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