E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/15.01.256

Research Article

Outcomes of Traumatic Dorsolumbar Spine Injuries Treated by Posterior Stabilization with Pedicle Screws

Dr. R N Suresh Kumar[1], Dr. Prabhakaran Rajendran[2], Dr. S Priyadharsini[3], Dr. S Kumar[4]

[1]Assistant Professor, Department of Orthopaedics, Government Mohan Kumaramangalam Medical College Salem, Tamilnadu
[2]Assistant Professor, Department of Orthopaedics, Government Medical College, Kallakurichi, Tamilnadu, India.
[3]Assistant Professor, Department of Anaesthesiology, Government Mohan Kumaramangalam, Medical College, Salem, Tamilnadu, India.
[4]Professor, Department of Orthopaedics, Government Medical College Dharmapuri, Tamilnadu, India.

Received Date: 10/02/2025 Accepted Date: 18/03/2025 Published Date: 12/04/2025

Corresponding Author: Dr. S Kumar, Professor, Department of Orthopaedics, Government Medical College Dharmapuri, Tamilnadu, India.
Email: dr_suresh04@yahoo.co.in

ABSTRACT

Background: Thoraco-lumbar spine fractures are common in polytrauma patients, frequently occurring at the transitional zone between the rigid thoracic and mobile lumbar spine. These fractures may be associated with neurological deficits and spinal instability, necessitating surgical intervention. Posterior stabilization with pedicle screw fixation is widely used to restore stability, correct deformity, and facilitate early mobilization. **Aim:** To evaluate the clinical, radiological, and neurological outcomes of posterior stabilization with pedicle screw fixation in thoraco-lumbar burst fractures. **Materials and Methods:** This prospective study included 25 patients with thoraco-lumbar burst fractures treated with posterior pedicle screw fixation. Clinical and neurological assessments were performed using ASIA scale and Frankel grading. Radiological parameters, including regional kyphotic angle and Beck's sagittal index, were measured pre-operatively, post-operatively, and during follow-up. Patients were followed for a minimum of one year. Functional outcomes were assessed using Denis pain and work scales. **Results:** The mean age was 38.4 years, with males predominating (68%). The most common mode of injury was fall from height (68%). The most frequently involved vertebra was D12 (37.9%), followed by L1 (27.5%). AO Type A fractures were most common (80%). Neurological improvement was observed in patients with incomplete deficits: 4 of 5 patients with Frankel D improved to Frankel E, and 1 of 2 patients with Frankel C improved to Frankel D. Patients with Frankel A showed no neurological recovery. The mean regional kyphotic angle improved from 16.56° pre-operatively to 10.44° at one year, with a mean correction of 6.12°.

Beck's index improved from 0.607 pre-operatively to 0.72 at one year. Most patients reported satisfactory pain relief and functional recovery. Complications were minimal and manageable, with no cases of implant failure or neurological deterioration.
Conclusion: Posterior stabilization with pedicle screw fixation is an effective and reliable method for managing thoraco-lumbar burst fractures. It provides good neurological recovery in incomplete injuries, significant deformity correction, early mobilization, and low complication rates.
Keywords: Thoraco-lumbar fracture, Burst fracture, Pedicle screw fixation, Kyphotic angle, Beck's index, Neurological recovery.

INTRODUCTION

Spine fractures are common occurrences in polytrauma patients. At least 65 to 80% of spine fractures are seen in thoraco-lumbar region [1]. Common causes include fall from height, motor vehicle accident/collision, direct assault etc. Fractures involving thoraco-lumbar region have a bimodal distribution involving active young individuals (usually males, < 40 years) due to high energy trauma or older age group years (usually females, > 50 years) due to trivial trauma in osteoporotic bone. [2]

Roughly 20% of spine fractures will present with neurological deficit.[2] Mortality in paraplegic patients at the end of 1 year is around 4% due to various morbidity related causes. [3] Most of the fractures in spine involves the thoraco-lumbar junction. This is because the thoracic spine is kyphotic, rigid and stabilized with ribs while the lumbar spine is lordotic and mobile. This transition zone is weak, experiencing more biomechanical stress and results in fracture when subjected to trauma. [2]

Stable fractures without neurological deficit can be treated conservatively, whereas, patients with neurological deficit and unstable fracture morphology may need surgical treatment. Posterior decompression and stabilization with pedicle screw fixation are done in such cases. Surgical stabilization of the spine may improve the chance of neurological recovery and also help in mobilizing the patient early improving nursing care and thereby reducing the morbidity and mortality.

MATERIALS AND METHODS

25 patients with thoraco-lumbar burst fractures were included in the study. After receiving in emergency department, patients who were suspected of spine injury were stabilized and resuscitated. The clinical status of the patients was examined. Thorough neurological examination was done and documented in ASIA chart and Frankel grading was done. Complete radiological examination was done with X-rays (both AP and lateral), CT scan and MRI.

In lateral view of X-ray, the regional kyphotic angle and Beck's sagittal index were measured and documented. CT scan was taken to study the degree of comminution and displacement of fragments. MRI was done to assess the intactness of posterior longitudinal ligament and the spinal cord status. Intravenous injection of Methylprednisolone was given according to NACIS III guidelines.

All the patients underwent posterior stabilization with pedicle screw fixation for thoraco-lumbar spine fractures under general anaesthesia.

Post-operatively, Patients were made to sit on first post-operative day. If patient's neurological status is intact, then they were made to stand and walk on the same day. If patient had neurological deficit, then passive or active mobilization were begun based on their neurological status. Mobilization was done with Taylor's brace for 12 weeks.

Neurological status was examined on 1st post-operative day, 12th post-operative day

and prior to discharge. All patients were followed up every 4 weeks in the first 6 months, then every 3 months, up-to a minimum of 1 year of total follow-up. Patients were also assessed with Dennis pain and work assessment scale at follow-ups.

OBSERVATION AND RESULTS

In our study the most common age group involved was between 21 – 30 years which included 9 patients (36%). The mean age was 38.4 years.

17 patients were male (68%) and 8 (32%) patients were female. The most frequent mode of injury was fall from height in 17 patients (68%) followed by RTA (road traffic accidents) in 8 patients (32%).

Since, 4 patients has multiple level fractures (at 2 levels), the total number of vertebral body fractures in 25 patients were 29. The most commonly fractured vertebra was D11(11, 37.9%) followed by L1 (8, 27.5%). The least commonly fractured vertebra in this study was L4 (1, 3.4%).

Majority of the cases has Type-A fracture of vertebra seen in 20 cases (80%) followed by Type-B fracture in 4 cases (16%). Only 1 case in our study had Type-C fracture (4%).

Posterior longitudinal ligament (PLL) was intact in 14 (56%) patients and was injured in 11 (44%) patients.

The pre-operative and post- operative neurological status of all the patients were analysed with ASIA scale and Frankel Grading.

Table 1: Pre-operative and Post-operative and neurological status of patients.

Frenkel Grading	Pre-operative		12 weeks post-operative		1-year post-operative	
E	16	64%	18	72%	20	80%
D	5	20%	4	16%	2	8%
C	2	8%	1	4%	1	4%
B	0	-	-	-	-	-
A	2	8%	2	8%	2	8%

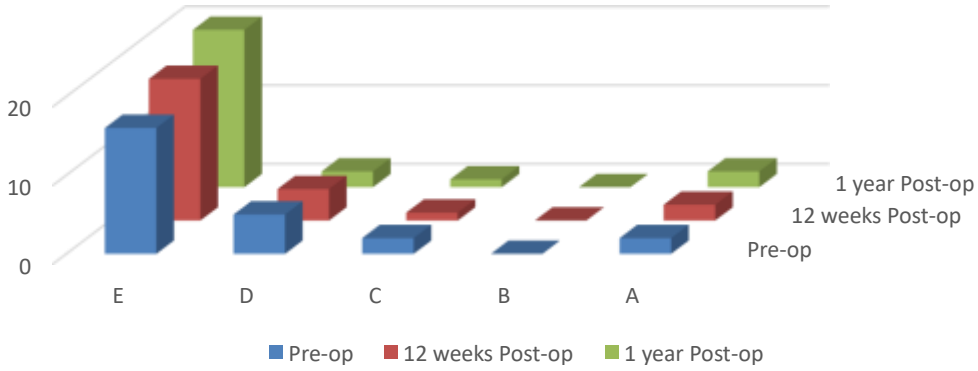

Chart 1: Pre-operative and Post-operative and neurological status of patients.

The following table the shows the progression of neurological status in patients pre-operatively and 1 year after surgery.

Table 2: Post- operative progression of neurological status of all patients.

Pre-operative Neurological status (Frankel Grading)	Post- operative status at 1 year follow-up
A ⟶ 2 cases	2 cases ⟶ A (no improvement)
B ⟶ 0 cases	NA
C ⟶ 2 cases	1 Case ⟶ D (improved by 1 grade)
	1 Case ⟶ C (no improvement)
D ⟶ 5 cases	4 cases ⟶ E (improved by 1 grade)
	1 case ⟶ D (no improvement)
E ⟶ 16 cases	16 Cases ⟶ E (no change in neurological function)

From the above table, we can see that, 2 patients with Frankel A grade maintained the same status without any improvement. No case of Frankel B was seen in our study. We had 2 cases of Frankel C grade, of which 1 case improved to Frankel D while the other maintained in Frankel C. There were 5 cases in Frankel D grade of which 4 cases improved to Frankel E, while 1 patient had no improvement. All the 16 patients of Frankel E maintained in Frankel E without any new onset of neurological deficit.

The mean pre-operative Beck's index was 0.607, which improved to 0.73 at 12 weeks post- operatively and to 0.72 at 1 year post operatively.

The mean pre-operative regional kyphotic angle was 16.56° which reduced to 10.28° at 12 weeks post-op and to 10.44° at 1 year post operatively.

According to Denis Pain scale, 11 patients (44%) had no pain, 9 patients (36%) had occasional pain without need for pain medication, 3 patients (12%) had moderate pain with need for occasional medication, 2 patients (8%) had moderate to severe pain with occasional absence from work, affecting their activities of daily living. No patient had constant chronic sever pain.

According to Denis work scale, 5 patients (20%) returned to their previous work/ heavy work, 6 patients (24%) were able to return to previous sedentary work or heavy work with restrictions, 7 patients (28%) were unable to return to previous work but were able to return to new sedentary work, 4 patients (16%) were unable to return to full time work and 3 patients (12%) were completely disabled and could not return to any work.

Post-operative Complications:

During the post-operative period, 2 patients developed superficial surgical site infection. For both these patients, IV antibiotics were started according to pus culture and sensitivity and regular dressing was done. Infection settled in both patients.

2 patients developed grade I bedsore, treated by air-bed and frequent position change educating the patient's care-givers. 1 patient developed grade III bedsore at 6 months follow-up due to improper care. Flap cover application was done for the patient.

2 Patients developed urinary tract infection who were on complete bladder drainage with Foley's catheter as they had poor bladder control. Bladder wash was given and catheter was changed. Appropriate antibiotics were given based on the urine culture and sensitivity.

DISCUSSION

About to 5 to 10% of poly-trauma patients attending emergency department suffer a spinal fracture. Approximately 20% of these

patients may develop some form of neurological deficit. Hence, treating a thoraco-lumbar spine fracture by appropriates means is essential to help in preventing neurological deficit or to rehabilitate the patient. The main goals of treatment should be (1) Restoring the anatomy and decompressing the spinal cord, (2) To prevent new onset or worsening of neurological deficit, (3) To help improve the neurological status of the patient, (4) Mobilize the patient at the earliest so that complications (like bedsore, DVT, Pulmonary infections etc.) associated with prolonged bed rest can be avoided, (5) Rehabilitate the patients to near pre- injury levels as much as possible.

The most common level of injury in our study was D12 in 37.9% of the cases, followed by L1 in 27.5 %. Comparing with other studies the most common levels to be involved in fracture of thoraco-lumbar spine is D12 and L1 followed by L2 vertebra. Comparison showing the level of injury with other studies is shown in the table below

.

Table 3: Comparing the level of injury with other studies

Study	D11	D12	L1	L2	OTHERS
Our study	6.8%	37.9%	27.5%	10.3%	17.5%
Ahmed M sallam *et al.*, 2019 [16]		23%	37.7%	29.6%	10.1%
Marco Cimatti *et al.*, 2013 [22]	6.25%	18.75%	50%	12.5%	12.5%
Ambrose W Y Yung, 2011[17]	5.3%	10.5%	26.3%	36.8%	21.1%
Farrokhi *et al.*, [23]	-	34.2%	57.9%	7.9%	-

Classifying fracture according to AO classification, type A (80%) was most common in our study, followed by type B in 16% and type C in 4% of the cases. The table below shows the comparison of fracture type between various studies, which also shows type A as most common type.

Table 4: Comparison of type of fracture

Study	AO- Type A	AO- Type B	AO- Type C
Our study	80%	16%	4%
Mohammed Mustafa Adawi *et al.*, 2019[20]	72.3%	16.6%	11.1%
Marco Cimatti *et al.*, 2013 [22]	87.5%	12.5%	-

The neurological status of all cases was assessed using the Frankel scoring system. Only a very few studies have compared the pre-operative neurological status with post-operative neurological status.

Table 5: Comparing Frankel scoring with various studies.

Study	Pre/post op	E	D	C	B	A
Our study	Pre-op	64%	20%	8%	0	8%
	Post-op	80%	8%	4%		8%
Mohammed Mustafa Adawi *et al.*, 2019 [20]	Pre-op	77.8%	11.1 %	5.55%	5.55%	-
	Post-op	88.9%	11.1 %	-	-	-
Ambrose W Y Yung, 2011 [17]	Pre-op	74%	26%	-	-	-
	Post-op	84.2%	15.8			

			%			
Ekapidhon *et al.*, 2009 [24]	Pre-op	62%	6.9%	6.9%	13.8%	10.4%
	Post-op	82.75%	6.9%	-	-	10.4%

The average kyphotic angle pre-operatively was 16.56° pre-operatively which improved to 10.28° at 12 weeks post-operative and to 10.44° at 1-year follow-up.

The mean correction from pre-operative status to one-year post-operative was 6.12°. Comparing with other studies we can see the average correction of kyphotic angle was around 6° to 7°.

Table 6: Comparison Regional Kyphotic angle and mean correction with other studies.

Study	Pre-op	Post-op	Follow-up	Mean Correction
Our study	16.56	10.28	10.44	6.12
Ambrose W Y Yung, 2011[17]	10.9	3.2	3.68	7.22
Alvine *et al.* [25]	12	1	6	6
Huang & Luo *et al.* [26]	9.63	2.51	2.51	7.12
Sasso *et al.* [27]	17.6	3.5	11.6	6

The mean Beck's index, which is ratio of anterior vertebral body height to posterior vertebral body height is 0.607 pre-operatively which improved to 0.73 post-op and 0.72 at 1-year follow-up. The post-operative Beck's index is comparable with the studies shown below.

Table 7: Comparison of Beck's index with other studies.

Study	Pre-op	Post-op	Follow-up
Our study	0.607	0.73	0.72
Mohammed Mustafa Adawi *et al.*, 2019 [20]	0.7	0.80	0.78
Ambrose W Y Yung, 2011 [17]	0.68	0.79	0.79

Very less complications were encountered in our study. 18 patients (72%) had no complications, 3 patients (12%) had pressure sores who were treated with air bed and wound debridement and flap-cover etc., 2 patients (8%) had superficial infection that settled with appropriate anti-biotics and 2 patients (8%) had UTI who were appropriately managed with anti- biotics bladder wash and maintaining catheter hygiene. No patient experienced complications like implant failure, screw pull-out, worsening of neurological deficit or new onset neurological deficit.

CONCLUSION

Early evaluation of fracture and the neurological status, appropriate planning and adequate fixation at the earliest can benefit the patient in neurological recovery, reducing the fracture pain and mobilizing the patient early thereby preventing complications. Thus, Posterior stabilization with pedicle screw fixation is an excellent option for stabilizing thoraco-lumbar spine fractures.

Authors:

Work Done At: Department of Orthopaedics, Government Mohan Kumaramangalam Medical College Hospital, Salem-636001, Tamilnadu, India.

Conflict Of Interest: Nil

Funding If Any: Nil

Corresponding Author and Address for Communication:

REFERENCES

1. Hasler RM, Exadaktylos AK, Bouamra O, *et al.* Epidemiology and predictors of spinal injury in adult major trauma patients: European cohort study. Eur Spine J. 2011;20:2174–2180.
2. Charles M. Court-Brown, James D. Heckman, Margaret M. McQueen, William M Ricci, Paul Tornetta: Rockwood and Greens Fractures in Adults, 8th edition: 1757- 1793.
3. Middleton JW, Dayton A, Walsh J, *et al.* Life expectancy after spinal cord injury: A 50-year study. Spinal Cord. 2012;50: 803–811.
4. Silver JR. History of the treatment of spinal injuries. Postgrad Med J. 2005 Feb;81(952):108-114. doi: 10.1136/pgmj.2004.019992. PMID: 15701743; PMCID: PMC1743190
5. Frederick M. Azar, James H Beaty, S. Terry Canale: Campbell's operative orthopaedics, 13th edition: 1801-1822.
6. Whitesides TE Jr. Traumatic kyphosis of the thoracolumbar spine. Clin Orthop Relat Res. 1977 Oct;(128):78-92.
7. Kelly RP, Whitesides TE Jr. Treatment of lumbodorsal fracture-dislocations. Ann Surg. 1968;167(5):705-717.
8. Jacobs RR, Schlaepfer F, Mathys R Jr, Nachemson A, Perren SM. A locking hook spinal rod system for stabilization of fracture-dislocations and correction of deformities of the dorsolumbar spine. A biomechanic evaluation. Clin Orthop Relat Res. 1984 Oct;(189):168-77.
9. Bucholz, Robert W; Heckman, James D; Court-brown, Charles M. Fractures and dislocations of thoracolumbar spine: Rockwood and Greens fractures in adults, 6th edition: 1548-1553
10. Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. Spine (Phila Pa 1976). 1983 Nov-Dec;8(8):817-31.
11. McCormack T, Karaikovic E, Gaines RW. The load sharing classification of spine fractures. Spine. 1994;19:1741–1744.
12. McAfee PC, Yuan HA, Fredrickson BE, *et al.* The value of computed tomography in thoracolumbar fractures. An analysis of one hundred consecutive cases and a new classification. J Bone Joint Surg Am. 1983;65:461–473.
13. Vaccaro AR, Zeiller SC, Hulbert RJ, *et al.* The thoracolumbar injury severity score: A proposed treatment algorithm. J Spinal Disord Tech. 2005;18:
14. Vaccaro AR, Lehman RA Jr, Hurlbert RJ, *et al.* A new classification of thoracolumbar injuries: The importance of injury morphology, the integrity of the posterior ligamentous complex, and neurologic status. Spine. 2005;30:2325–2333.
15. Bracken MB, Shepard MJ, Holford TR, Leo-Summers L, Aldrich EF, Fazl M, Fehlings M, Herr DL, Hitchon PW, Marshall LF, Nockels RP, Pascale V, Perot PL Jr, Piepmeier J, Sonntag VK, Wagner F, Wilberger JE, Winn HR, Young W. Administration of methylprednisolone for 24 or 48 hours or tirilazad mesylate for 48 hours in the treatment of acute spinal cord injury. Results of the Third National Acute Spinal Cord Injury Randomized Controlled Trial. National Acute Spinal Cord Injury Study. JAMA. 1997 May 28;277(20):1597-604.
16. Ahmed M. Sallam1 , Walid A. Abdel Ghany2,3*, Ali Kotb Ali2 , Mohamed A. Habib2 , Ahmed F. Toubar2 , Mohamed S. Kabil2 , Ahmed Abdel Barr Salem2 , Sherif H. Abouzeid Mourad2 and Mohamed A. Nada. Short-segment posterior fixation with index level screws versus long segment posterior fixation for thoracolumbar spine fracture: angle of correction and pain. Egyptian Journal of Neurosurgery (2019) 33:11
17. Yung AW, Thng PL. Radiological outcome of short segment posterior stabilisation and fusion in thoracolumbar spine acute fracture. Ann Acad Med Singap. 2011

Mar;40(3):140-4.

18. Himanshu Rohela. Management of fractures of thoracolumbar spine with pedicle screw fixation. Journal of Health Research and Reviews. May - August 2016,Volume 3,Issue 2: 55-59.
19. Khare S, Sharma V. Surgical outcome of posterior short segment trans-pedicle screw fixation for thoracolumbar fractures. J Orthop. 2013;10(4):162-167.
20. Adawi, M.M., Aboulfetouh, I., Saleh, A. et al. Posterior short-segment fixation with implanting pedicle screw in the fractured level as a feasible method for treatment of thoracolumbar fracture. EgyptJ Neurosurg 34, 6 (2019). https://doi.org/10.1186/s41984-018-0026-3
21. Razak M, Mahmud MM, S.A. Hyzan MY, Omar A, Short segment posterior instrumentation, reduction and fusion of unstable thoracolumbar burst fractures- a review of 26 cases, Med J Malaysia, 2000, Sep, 55 Suppl, C: 9-13.
22. Cimatti M, Forcato S, Polli F, Miscusi M, Frati A, Raco A. Pure percutaneous pedicle screw fixation without arthrodesis of thoraco-lumbar fractures: clinical and radiological outcome with 36-month follow-up. Eur Spine J. 2013;22 Suppl 6(Suppl 6):S925-S932. doi:10.1007/s00586-013-3016-x
23. Farrokhi MR, Razmkon A, Maghami Z, Nikoo Z. Inclusion of the fracture level in short segment fixation of thoracolumbar fractures. Eur Spine J. 2010; 19(10):1651-1656.
24. Suwit Ekapichon. Intermediate Screws in Short Segment Pedicular Fixation for Thoracolumbar and Lumbar Burst Fractures. The Thai journal of orthopaedic surgery, vol. 33 no. 1 june 2009: 10-15
25. Alvine GF, Swain JM, Asher MA, Burton DC. Treatment of thoracolumbar burst fractures with variable screw placement or Isola instrumentation and arthrodesis: case series and literature review. J Spinal Disord Tech. 2004 Aug;17(4):251-64.
26. Weijie Huang and Tao Luo. Efficacy analysis of pedicle screw internal fixation of fractured vertebrae in the treatment of thoracolumbar fractures. Experimental and therapeutic medicine 5: 678-682, 2013
27. Sasso RC, Cotler HB, Reuben JD. Posterior fixation of thoracic and lumbar spine fractures using DC plates and pedicle screws. Spine (Phila Pa 1976). 1991 Mar;16(3 Suppl):S134-9
28. Zhao QM, Gu XF, Yang HL, Liu ZT. Surgical outcome of posterior fixation, including fractured vertebra, for thoracolumbar fractures. Neurosciences (Riyadh). 2015;20(4):362-367. doi:10.17712/nsj.2015.4.20150318.
29. Jonathan-James.Short Same-Segment Fixation of Thoracolumbar Burst Fractures. Hawai'I Journal Of Medicine & Public Health, January 2012;Vol 71, No 1;19-22.
30. El-Sawy&Rayan. Fixation of fractured level in short segment thoracolumbar fracture; El-Minia med. Bull. Vol. 23, no. 2, june, 201249-55.
31. Jin-Ho HWANG, Hitesh N. MODI; Short segment pedicle screw fixation for unstable T11-L2 fractures: with or without fusion? A three-year follow-up study; ActaOrthop. Belg., 2009, 75, 822-827.