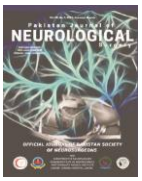


PAKISTAN JOURNAL OF NEUROLOGICAL SURGERY (QUARTERLY) – OFFICIAL JOURNAL OF PAKISTAN SOCIETY OF NEUROSURGEONS

Original Article

The Radiological Outcome of Thoracolumbar Spine Fracture Fixation in Short Vs Long Segment

Ehtisham Ahmed khan Afridi[1], Idrees Ahmed[1], Sidra Maqbool[2], Aqsa Shahzadi[1], Saadia Maqbool[1]
[1]Department of Neurosurgery and [2]Pathology, Ayub Teaching Hospital, Abbottabad

ABSTRACT

Objectives: The study determined the radiological outcomes of short-segment vs. long-segment fixation of thoracolumbar spine fractures.

Materials and Methods: A total of 322 patients (18 – 60 years) with thoracolumbar spine fractures were included. Preoperative X-rays and CT scans were performed on all patients to determine the integrity and orientation of the pedicle. Cobb's approach was also used to estimate the kyphotic angle on x-rays. The posterior pedicle 65 screw fixation was used in all instances. Group A (N = 161) received long segment fixation at least two levels above and below the fractured vertebra, while Group B (N = 161) received short segment fixation with pedicle screws placed in the broken level as well as one level above and below the fractured level.

Results: In Group A, the mean age was 38 years, and the mean length of fracture was 45 hours; in Group B, the mean age was 43 years, and the mean duration of fracture was 46.354 hours. A good radiological outcome was observed in 115 (71.4%) patients in group A as compared to 103 (64%) patients in group B. A radiological outcome (p-value: 0.049) of a duration greater than 8 hours was observed in both groups (A: 75.5%; B: 58.1%).

Conclusion: Short segment fixation using a pedicle screw at the level of fracture provides comparable correction to long segment fixation.

Keywords: Thoracolumbar Fractures, Short Segment, Long Segment, Radiological Outcome.

Corresponding Author: Ehtisham Ahmed Khan Afridi
Assistant Professor, Neurosurgery ATH
Email: ehtisham81@gmail.com

Date of Submission: 07-07-2022
Date of Revision: 18-08-2022
Date of Acceptance: 09-09-2022
Date of Online Publishing: 30-9-2022
Date of Print: 30-9-2022

DOI: 10.36552/pjns.v26i3.778

INTRODUCTION

Before 2000, the most prevalent age group for thoracolumbar spine injury was 15 – 29 years old, but currently, the median age is 35.1. Approximately 27% of thoracolumbar junction injury patients experienced neurological impairments, which has a negative impact on society owing to a lifetime disability, lengthy rehabilitation, and lost productive economic

years.[1] Approximately 70% of these spinal fractures do not result in acute neurological impairment, and 55% subsequently recover neurologically. 45% of those who have neurological symptoms have incomplete spinal damage, whereas 19% have a full spinal injury. T10 – L2 spine fractures account for up to 75% of all spine fractures.[2] King et al,[10] were the first to disclose the use of vertebral body screw fixation using a trans facet approach to the lumbar spine in 1944. In 1958, Boucher pioneered a method for piercing screws into the vertebral body via the pedicle. After it was developed and recommended by Roy-Camille and colleague[12] in 1963, the pedicle screw fixation has been frequently employed in lumbar spine surgery.[10-13]

Over 250,000 patients now have permanent impairments from spinal cord injuries. Thoracic fractures are caused by blunt trauma in 1.9% of cases.[3] The prevalence of thoracolumbar junction fractures following motor vehicle accidents is around 2.4%, however, it has been rising over time. Thoracolumbar junction fractures occurred in 6.9% of blunt trauma patients. Several fractures were missed on ordinary X-ray pictures. Motor vehicle accidents were the most prevalent four mechanisms among adults, accounting for 36.70% of occurrences, followed by falls from great heights (31.70%).[1-4] Spinal stability and alignment restoration, correction of kyphotic deformity, and spinal canal decompression are all treatment aims for thoracolumbar burst fractures.[5-6] Since then, many surgical strategies for treating thoracolumbar burst fractures have emerged, including posterior short segment or long segment pedicle screw fixation, direct anterior decompression using corpectomy, and mixed therapies using anterior and posterior spinal approaches.[6]

According to Ahsan et al., in the short segment-group, 22.22%, 58.33%, and 19.44% of cases had excellent, good, and fair clinical outcomes, while in the long segment-group, 34.61%, 48.08%, 11.54%, and 5.77% cases had excellent, good, fair, and poor clinical outcomes, respectively.[7] El-Shehaby et al, found that in the care of a thoracolumbar fracture, a positive radiological result was 56% with a short section and 71% with a long segment.[8] Long posterior fixation using pedicle screws and rods two levels above and below the fracture level improves fixation; nevertheless, it may result in superfluous equipment and greater pressure on the lower discs. Short posterior fixation with pedicle screws and linked rods one level above and below the fracture level, on the other hand, not only restricts the number of fused segments but also minimizes excessive strains on the neighboring discs. The research compared the radiographic results of short-segment vs. long-segment thoracolumbar spine fracture stabilization.

MATERIAL AND METHODS

Study Design & Setting

A randomized controlled trial (RCT) was conducted in the department of Neurosurgery at the Ayub Teaching Hospital, KPK, from 1st July 2020 to 31st December 2021. A total of 322 patients were included.

Inclusion Criteria

Patients of both genders with thoracolumbar spine fractures were included with ages ranging from 18 – 60 years.

Exclusion Criteria

Patients excluded who received conservative treatment. Patients with multiple spinal fractures were excluded. Patients also excluded with a history of severe neurological deficits.

Data Collection Procedure

Patients from the Department of Neurosurgery, ATH, Abbottabad, who met the inclusion criteria, were included in the research after approval from

the ethical committee. Patients provided informed consent. Basic demographic information (age, gender, fracture duration) was collected. Block randomization was used for randomization. There were 161 patients in the long segment group, or Group A, and 161 patients in the short segment group, or Group B.

Clinical & Surgical Management

Preoperative CT scans were performed on all patients to determine the integrity and orientation of the pedicle. Cobb's approach was also used to estimate the kyphotic angle on x-rays. The posterior pedicle 65 screw fixation was used in all instances. Group A received long segment fixation at least two levels above and below the fractured vertebra, while Group B received short segment fixation with pedicle screws placed in the broken level as well as one level above and below the fractured level.

In all instances, we conducted laminectomy at the fracture level. All instances were fused utilizing the spinous process and laminectomy bone. After one, three, and six months, patients obtained X-rays to ensure correct screw placement and kyphotic angle reduction. Both groups had good radiological outcomes three months following the treatment, which were documented on specially constructed proforma.

Data Analysis:

The statistical analysis program SPSS version 22 was used to analyze the data. For qualitative characteristics such as gender and favorable radiological result, frequency and percentage were calculated. For quantitative characteristics such as age and fracture duration, mean SD was provided. The Chi-square test was used to compare favorable radiological outcomes in both groups.

RESULTS

Age Distribution

The age of patients was between 18 – 60 years. The mean age of 38.099 ± 8.11 years in group A, and 43.198 ± 8.32 years in group B (Table 1).

Table 1: Shows age in years and duration of fracture in hours.

Demographics	Group A N = 161	Group B N = 161
Age in Years	38.099 ± 8.11	43.198 ± 8.32
Duration of Fracture	45.602 ± 9.26	46.354 ± 9.50

Gender Distribution

There were 75.2% male patients in group A, whereas 78.9% in group B. There were 24.8% female patients in group A and 21.1% in group B. The male gender was dominant in both groups (Table 2).

Table 2: Shows male and female percentages in both groups.

Gender	Group A	Group B
Male	121 (75.2%)	127 (78.9%)
Female	40 (24.8%)	34 (21.1%)
Total	161 (100%)	161 (100%)

Duration of Fracture

The mean duration of fracture was 45.602 ± 9.26 hours in Group A and the mean duration of fracture was 46.354 ± 9.50 hours in Group B (Table 1).

Outcomes

A good radiological outcome was observed in 115 (71.4%) patients in group A, as compared to 103 (64%) patients in group B (Table 3). A good radiological outcome in a duration of fewer than 8 hours was observed in group A (69.4%) and group B (67.7%). Similarly, a radiological outcome

of a duration, greater than 8 hours was observed in group A (75.5%) and group B (58.1%). A significant difference exists between good radiological outcomes in the long segment and short segment groups in a duration greater than 8 hours (Tables 4 – 5).

Table 3: Shows Good Radiological Outcomes in both Groups.

Good Radiological Outcome	Group A	Group B	P-Value
Yes	115 (71.4%)	103 (64%)	0.153
No	46 (28.6%)	58 (36%)	(insignificant
Total	161(100%)	161(100%)	result)

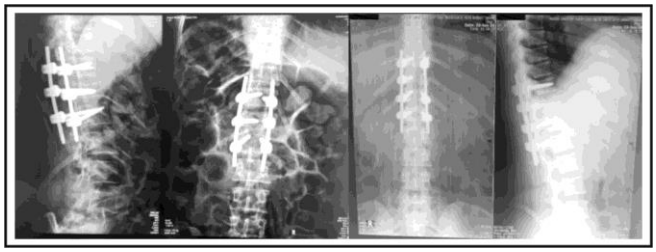
Table 4: Shows Good Radiological Outcomes in both Groups with a Duration of fewer than 48 hours.

Good Radiological Outcome (< 48 Hours)	Group A	Group B	P-Value
Yes	75 (69.4%)	67 (67.7%)	0.784 (insignificant
No	33 (30.6%)	32 (32.3%)	result)

Table 5: Shows Good Radiological Outcomes in both Groups with a Duration of more than 48 hours.

Good Radiological Outcome(> 48 Hours)	Group A	Group B	P-Value
Yes	40(75.5%)	36(58.1%)	0.049 (significant
No	13(24.5%)	26(41.9%)	result)

Figure 1: Transforaminal Lumbar Interbody Fusion (TLIF).



(a) (b)

Figure 2: Pedicle Screw Fixation.

CT Findings

Figure 1 shows transforaminal Lumbar Interbody Fusion (TLIF). Figures 2 (a and b) show pedicle screw fixation.

DISCUSSION

Patients with thoracolumbar spine junction injuries report neurological abnormalities, which have a detrimental impact on society because of persistent disability and lost productive economic years due to protracted rehabilitation. The current research compared the radiographic results of short-segment vs. long-segment thoracolumbar spine fracture stabilization. Half of the patients had long segment fixation at least two levels above and below the fractured vertebra, whereas the other half had short segment fixation with pedicle screws put in the broken level and one level above and below the fractured level. A satisfactory radiological result was seen in 115 (71.4%) of group A patients compared to 103 (64%) of group B patients. A radiological result of a duration higher than 8 hours was found in both groups (A: 75.5%; B: 58.1%). A significant difference appears between good radiological outcomes in the long segment and short segment groups for a period of more than 8 hours.

The goals of treating vertebral fractures are to

achieve early neurological deficit recovery, anatomically overcome injured spinal segments, and achieve strong and stable fixation for early rehabilitation.[9] Sasso and Cotler[14] conducted a clinical investigation in which they compared spine pedicle screw fixation to other tools such as Harrington rods, hooks, Luque rods, and sublaminar wires. When compared to other fixation methods, pedicle screw fixation was determined to be a posterior fixation that may be employed as a shorter segment fixation. The pedicle screw system has certain drawbacks. In theory, the pedicle screw fixation system can endure both bending and axial stresses and may be utilized as a cantilever beam fixation system to correct angular deformity and restore height. However, when the vertebral body is severely injured and associated with considerable height loss or aberrant angulation, the system's biomechanical stability suffers greatly. The immediate axial rotation (IAR) is carried posteriorly away from the injury, leading to kyphotic angulation.[15-16] As a result, load-sharing classification is an excellent guide for determining the suitability of short-segment posterior instrumentation for spine fractures.

According to numerous research, the loss of degree correction or implant failure emerged 6 to 12 months following surgery.[17-18] Out of 48 patients who had dorsal short-segment fixation in thoracolumbar fracture, Lee et al.[20] reported 6 occurrences of implantation failure. Two out of six failure cases were osteoporotic patients. According to Yung and Thng,[21] there was a case of loss of kyphotic correction among the 20 patients on the most recent examination. The patient was an elderly lady with osteoporosis. As a result, for osteoporotic patients, we should consider lengthy segment fixation and avoid finishing instrumentation inside the kyphotic segment. Finkelstein et al,[22] 21-patient cohort analysis of thoracolumbar Chance fractures treated surgically with a single-level short-segment posterior stabilization and posterolateral autograft fusion was done. A 20-month follow-up examination revealed a substantial reduction in kyphosis from 10.1° to 0.9°. The mean Oswestry score was 11.5 and 88% of the patients had limited impairment.

Spine fusion surgery is becoming more common; however, the patient experience varies and the expense is expensive. ERAS routes can give a consistent approach for spine fusion cases, enhancing the quality of treatment and lowering costs.[25] Ishikawa et al, [26] sets intended to compare the surgical results of short-segment for osteoporotic vertebral collapse with neurological impairment in the thoracolumbar spine. They gathered information from 133 patients at 27 university hospitals and allied institutions. They classified the patients into two groups: one with 2- or 3-segment fusion and another with 4- to 6-segment fusion. There were no significant differences between the two groups in terms of neurological recovery, pain scale ratings, or complications. The S group had a shorter surgical time and less blood loss; however, the L group had a better LKA and corrected loss at the last follow-up. Although short-segment (vertebroplasty with posterior spinal fusion) ensures less invasiveness and validity of pain and neurological alleviation, surgeons should be cautious of corrective loss.

Dai et al,[23] investigated the randomized prospective design with and without fusion for short-segment posterior instrumentation. They showed good outcomes in terms of kyphotic angle correction radiological findings and clinical outcomes in the total short-segment posterior instrumentation with or without fusion. Mahar et al,[24] discovered in a cadaveric biomechanical investigation that segmental screw fixation, might increase axial torsion force at short segment posterior fixation (one level up and down). In terms of axial torsion stability, the insertion of pedicles at the fracture level can operate as reinforcement. This can be recommended to enhance the fabrication of short-segment pedicle

screws. In individuals with osteoporotic compression fractures, surgical intervention is rarely necessary. Patients with osteoporosis, on the other hand, maybe at risk of developing specific spinal diseases and may have a coexisting spinal illness that demands surgery. Although the majority of such individuals do not require spinal instrumentation, it can be used safely provided certain criteria are followed. Using several sites of fixation, accepting fewer degrees of deformity correction or conducting additional anterior release and fusion if maximal correction is required, and taking care not to stop the instrumentation inside a kyphotic segment are all examples. Better perioperative medical care for such patients, as well as developments in biochemical, molecular, and biomechanical approaches, may have the potential to enhance patient outcomes.[27]

CONCLUSION

In a periodlarger than 8 hours, a substantial difference occurs between favorable radiological results in the long segment and short segment groups. Finally, short segment fixation with a pedicle screw at the fracture level yields similar correction to long segment fixation in thoracolumbar burst fractures. Correction loss can be decreased by selecting cases for short-segment fixing. Short segment fixation should only be used in cases of kyphosis. Load shearing classification is crucial for identifying patients for short-segment instrumentation. A long-term follow-up investigation, however, will be necessary to corroborate our findings.

REFERENCES

1. Katsuura Y, Osborn JM, Cason GW. The epidemiology of thoracolumbar trauma: a meta-analysis. J Orthop. 2016; 13 (4): 383-8.
2. Liu B, Zhu Y, Liu S, Chen W, Zhang F, Zhang Y. National incidence of traumatic spinal fractures in China: data from china national fracture study. Medicine, 2018; 97 (35): e12190.
3. Bizimungu R, Alvarez S, Baumann BM, Raja AS, Mower WR, Langdorf MI, et al. Thoracic spine fracture in the Panscan Era. Ann Emerg Med. 2020; 76 (2): 143-8.
4. Doud AN, Weaver AA, Talton JW, Barnard RT, Meredith JW, Stitzel JD, et al. Has the incidence of thoracolumbar spine injuries increased in the United States from 1998 to 2011? Clin Orthop Relat Res. 2015; 473 (1): 297-304.
5. Li B, Sun C, Zhao C, Yao X, Zhang Y, Duan H. Epidemiological profile of thoracolumbar fracture (TLF) over a period of 10 years in Tianjin, China. J Spinal Cord Med. 2019; 42 (2): 178-83.
6. Aly TA. Short segment versus long segment pedicle screws fixation in management of thoracolumbar burst fractures: meta-analysis. Asian Spine J. 2017; 11 (1): 150-60.
7. Ahsan MK, Mamun AA, Zahangiri Z, Awwal MA, Khan SI, Zaman N, et al. Short-segment versus long-segment stabilization for unstable thoracolumbar junction burst fractures. Mymensingh Med J. 2017; 26 (4): 762-74.
8. El-Shehaby A, Saoud K, Elayouty A. Comparison of long segment fixation versus short segment fixation with pedicle screws at the level of the fracture in the management of thoracolumbar fractures. Egy Spine J. 2013; 5: 47-52.
9. Lee YS, Sung JK. Long-term follow-up results of short-segment fixation for unstable thoracolumbar junction fracture. J Korean Neurosurg Soc. 2005; 37: 416-21.
10. King D. Internal fixation for lumbosacral fusion. J Bone Joint Surg Am. 1948; 30: 560-5. 95.
11. Boucher HH. A method of spinal fusion. J Bone Joint Surg Br. 1959; 41: 248-59.
12. Roy-Camille R, Saillant G, Mazel C. Internal fixation of the lumbar spine with pedicle screw plating. Clin Orthop Res. 1986; 203: 7-17.
13. Han IH, Song GS. Thoracic pedicle screw fixation and fusion in unstable thoracic spine fractures. J Korean Neurosurg Soc. 2002; 32: 334-40.
14. Sasso RC, Cotler HB. Posterior Instrumentation and fusion for unstable fractures and fracture-dislocations of the thoracic and lumbar spine: a comparative study of three fixation devices in 70 patients. Spine, 1993; 18: 450-60.

15. Gertzbein SD, Holtby R, Tile M. Determination of a locus of instantaneous centers of rotation of the lumbar disc by Morie Fringes: a new technique. Spine, 1984; 9: 409-13.
16. Schmidt H, Heuer F, Claes L, Wike HJ. The relation between the instantaneous center of rotation and facet joint force: a finite element analysis. Clin Biomech. 2008; 23: 270-8.
17. McCormack T, Karaikovic E, Gaines RW. The load shearing classification of spine fractures. Spine, 1994; 19: 1741-4. 96.
18. McLain RF, Sparling E, Benson DR. Early failure of short-segment pedicle instrumentation for thoracolumbar fractures: A preliminary report. J Bone Joint Surg Am. 1993; 73A: 162-7.
19. Sasso RC, Cotler HB, Reuben JD. Posterior fixation of thoracic and lumbar spine fractures using DC plates and pedicle screws. Spine, 1991; 16 (3 Suppl): 134-9.
20. Lee YS, Sung JK. Long-term follow-up results of short-segment posterior screw fixation for thoracolumbar burst fractures. J Korean Neurosurg. 2005; 37: 416-21.
21. Yung AW, Thng PL. Radiological outcome of short segment posterior stabilisation and fusion in thoracolumbar spine acute fracture. Annals of the Academy of Medicine-Singapore, 2011; 40 (3): 140.
22. Finkelstein JA, Wai EK, Jackson SS, Ahn H, Brighton-Knight M. Single-level fixation of flexion distraction injuries. J Spinal Disord Tech. 2003; 16:2 36-42.
23. Dai LY, Jiang LS, Jiang SD. Posterior short-segment fixation with or without fusion for thoracolumbar burst fractures: a five to seven-year prospective randomised study. J Bone Joint Surg Am. 2009; 91: 1033-41.
24. Mahar A, Kim C, Wedemeyer M, Mitsunaga L, Odell T, Johnson B, et al. Short-segment fi fixation of lumbar burst fracture using pedicle fixation at the level of the fracture. Spine, 2007; 32: 1503-7.
25. AlSaleh K, Murrad K, AlZakri A, Alrehaili O, Awwad W. Enhanced Recovery Pathway in Adults Undergoing Elective Posterior Thoracolumbar Fusion Surgery: Outcomes Compared with a Traditional Care Pathway. Advances in Orthopedics 2021; 2021.
26. Ishikawa Y, Watanabe K, Katsumi K, Ohashi M, Shibuya Y, Izumi T, Hirano T, Endo N, Kaito T, Yamashita T, Fujiwara H. Short-versus long-segment posterior spinal fusion with vertebroplasty for osteoporotic vertebral collapse with neurological impairment in thoracolumbar spine: a multicenter study. BMC Musculoskeletal Disorders, 2020; 21 (1): 1-8.
27. Hu SS. Internal fixation in the osteoporotic spine. Spine, 1997; 22: 43S-48S.

Additional Information

Disclosures: Authors report no conflict of interest.
Ethical Review Board Approval: The study was conformed to the ethical review board requirements.
Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of
1.	Ehtisham Ahmed Khan Afridi	Study Design, Methodology, and Paper Writing.
2.	Idrees Ahmed	Data Calculation and Data Analysis.
3.	Ehtisham Ahmed	Interpretation of Results.
4.	Sidra Maqbool	Statistical Analysis.
5.	Aqsa Shahzadi	Literature Review.
6.	Saadia Maqbool	Literature Review and Quality Insurer.