

Original Article (SPINE)

Outcome of Transpedicular Fixation in Thoracolumbar Fractures

Mahmood Khan Kibzai¹, Muhammad Haroon¹, Muhammad Shoaib Kibzai², Zeenat-un-Nisa³

¹Sandeman Provincial Trauma Center Hospital, ²Department of Neurosurgery, Sheikh Khalifah Bin Zayyad Hospital, ³Sandeman Provincial Hospital, Quetta

ABSTRACT

Objective: The purpose of this study was to assess the clinical improvement in the post-op period in patients with thoracolumbar fractures who underwent transpedicular fixation.

Materials and Methods: A retrospective study was conducted for 6 months in the Neurosurgery departments of private hospitals in Quetta. A total of 34 patients with trauma were included in the study who underwent Transpedicular screws and rods fixation (Including both long and short segment fixation). American Spinal Injury Association (ASIA) impairment scale was used to describe the individual's functional impairment from spinal cord injury. Preoperative and postoperative comparison within 6 months.

Results: There were 22 male and 12 female patients. The patients were between 18-45 years of age. There were 16 cases of the following vertebral fractures: D9, D10, D12, L1 in ASIA-A and ASIA-B grades. There were 6 cases of the following vertebral fractures: L1, L2 in ASIA-C grades. And 12 cases of L2, L3 vertebral fractures in ASIA-D and ASIA-E Grades. In ASIA Grade A, 25% of patients improved to ASIA C and 12.5% of patients improved to ASIA D postoperatively. In ASIA Grade B, 25% of patients improved to ASIA C, and 25% of patients improved to ASIA-D post-operatively. In ASIA-C Grade, 16.6% of patients improved to ASIA E, and 50% of patients improved to ASIA D postoperatively.

Conclusion: In a considerable proportion of individuals, surgery resulted in superior clinical results. ASIA Grades A and B should also be operated early for greater clinical improvement.

Keywords: Transpedicular Fixation, Thoracolumbar fractures, ASIA Scores.

Corresponding Author: Dr. Muhammad Shoaib Kibzai
Sandeman Provincial Trauma Center Hospital, Quetta
Email: shoaib20695@yahoo.com

Date of Submission: 02-02-2022
Date of Revision: 28-03-2022
Date of Revision: 29-03-2022
Date of Online Publishing: 31-03-2022
Date of Print: 31-03-2022

DOI: 10.36552/pjns.v26i1.658

INTRODUCTION

Short-segment instrumentation (fixation of one normal vertebra above and below a damaged segment) has gained regular clinical practice due to advancements in transpedicular screw fixation methods and instrumentation systems.¹⁻² Posterior surgical instrumentation with pedicle screws and posterolateral fusion is a safe, dependable, and successful approach for treating new thoracolumbar fractures. Fusion aids in the

reduction of postoperative corrective loss of radiological characteristics.³ The use of pedicle screws, which may restrict the range of spinal segments better than hook and wire fixation to minimize soft tissue damage and increase the incidence of synostosis, extends the exceptional functions of pedicle screws indicated by studies.^{1,4} Pedicle screws are beneficial in severe fractures such as fracture-dislocation and can be utilized in both the lumbar and thoracic vertebrae. According to documented sources, the infection rate is around 6%. However, no infection was seen in this research following posterior fixation and synostosis. Patients with thoracic and lumbar segmental fractures who did not have nerve injury fared well with the temporizing techniques. It has also been observed that patients with thoracic and lumbar segmental fractures who did not have nerve injury might return to their normal lives more quickly after undergoing surgical spinal fixation, however, these findings were unrelated to radiographic findings. There was no significant bending of screws or hardware breakage. An early gradual osseous collapse was seen in a paraplegic patient, although there was no increase in discomfort.⁵⁻⁶ The primary benefit of surgical internal fixation over interim therapies is that early fixation allows patients to be mobile sooner, minimizing nerve damage by supporting the spine. It protects injured structures from external forces while enhancing the potential of neurological problems being restored and damaged structures being replaced with suitable internal fixation techniques. Treatments based on postures should be sufficient, and patients should be able to move after regaining stability through long-term relaxation.⁷⁻⁹ A study found that the incidence of intraoperative complications and post-operative fatigue failures of transpedicular screw-rod devices is directly related to the experience of the surgeon performing the surgery, so these procedures should be performed by only well-trained and spine-oriented surgeons.¹⁰ The goal of this study was to

evaluate postoperative clinical improvement in patients with thoracolumbar fractures who had transpedicular fixation.

MATERIALS AND METHODS

A retrospective study was conducted for 6 months in Neurosurgery departments of private settings (Yaseen hospital, Sultan Tareen hospital, and Akram hospital) in Quetta. Ethical review permission was taken before the conduction of the study. A total of 34 patients were included in the study.

Inclusion Criteria

Trauma cases included road traffic accidents and falls from heights. A total of 34 patients with trauma were included in the study who underwent transpedicular screw and rod fixation (including both long and short segment fixation).

Exclusion Criteria

We excluded patients with osteoporotic fractures, severe head injuries, TB spine cases, and metastatic spine fractures.

Data Collection

Patients were included as per defined selection criteria along with their informed consent after receiving approval from the hospital ethical committee. American Spinal Injury Association (ASIA) impairment scale was used to describe the individual's functional impairment from spinal cord injury. Preoperative and postoperative comparison within 6 months. A pre-designed proforma was used to record the data. The data was processed in SPSS version 26.0.

American Spinal Injury Association (ASIA) Scoring

Grade A includes complete sensory and motor deficit. Grade B includes complete motor loss and

incomplete sensory loss. Grade C includes incomplete motor deficit. Less than half of the muscles have muscle grade 3 or less. Grade D includes incomplete motor function. More than half of key muscles have muscle grade 3 or less. Grade E includes normal individuals with no sensory or motor deficits.¹¹

Surgical Procedure

After completing a standard posterior approach on the necessary vertebral levels, the C-arm was used to take lateral and anterior view x-rays of the target level vertebral body pedicles after making pilot hole with pedicle awl. Following that, the pedicle seeker was used to cross the pedicle into the vertebral body using the route of least resistance. A pedicle probe was then utilized to feel for any breaches in the pedicle walls. Holes were redirected when needed. Following that, pedicle screws were placed using fluoroscopic anteroposterior and lateral guidance. Appropriate length rods were connected to the screws. Bone pieces were placed posterolaterally for intervertebral fusion to take place.

RESULTS

Gender & Age Distribution:

There were 22 male and 12 female patients. The patients were between 18 – 45 years of age.

Injuries Pertinent to ASIA Grades

There were 16 cases of the following vertebral fractures: D9, D10, D12, L1 in ASIA-A and ASIA-B grades. There were 6 cases of the following

vertebral fractures: L1, L2 in ASIA-C grades. And 12 cases of L2, L3 vertebral fractures in ASIA-D and ASIA-E Grades.

Outcome

A total of 8 patients was reported in ASIA Grade A. In this group, 2 (25%) patients improved to ASIA C and 1 (12.5%) patient improved to ASIA D postoperatively. A total of 8 patients was reported in ASIA Grade B. In this group, 2 (25%) patients improved to ASIA C, and 2 (25%) patients improved to ASIA-D post-operatively (See Table 1).

A total of 6 patients were reported in Asia-C Grade. In this group, 1 (16.6%) patient improved to ASIA E, and 3 (50%) patients improved to ASIA D postoperatively. Total 4 patients presented with ASIA Grade D. In this group 4 (100%) patients improved to ASIA E post-operatively. Total of 8 patients presented in ASIA Grade E. In this group, patients remained in the ASIA E group (See Table 1).

Complications

Bedsore were reported in 10 patients, screw breakage in 2 patients, and wound infection in 7 patients.

Radiography

Fractured D10 vertebral body and spondylolisthesis at the time of admission are shown in Figure 1. Postoperative X-rays show the restoration of the spine after transpedicular screw fixation. See Figure 2.

Table 1: Post-op improvements in ASIA Scores after (N = 34).

ASIA Grades (at admission)	ASIA Grades	N=34 (Total Patients)	Improvement in ASIA Grades				
			Grade A	Grade B	Grade C	Grade D	Grade E
	Grade A	N = 8 (23.5%)			2 (25%)	1 (12.5%)	
	Grade B	N = 8 (23.5%)			2 (25%)	2 (25%)	
	Grade C	N = 6 (17.6%)				3 (50%)	1 (16.6%)
	Grade D	N = 4 (11.7%)					4 (100%)
	Grade E	N = 8 (23.5%)					8 (100%)

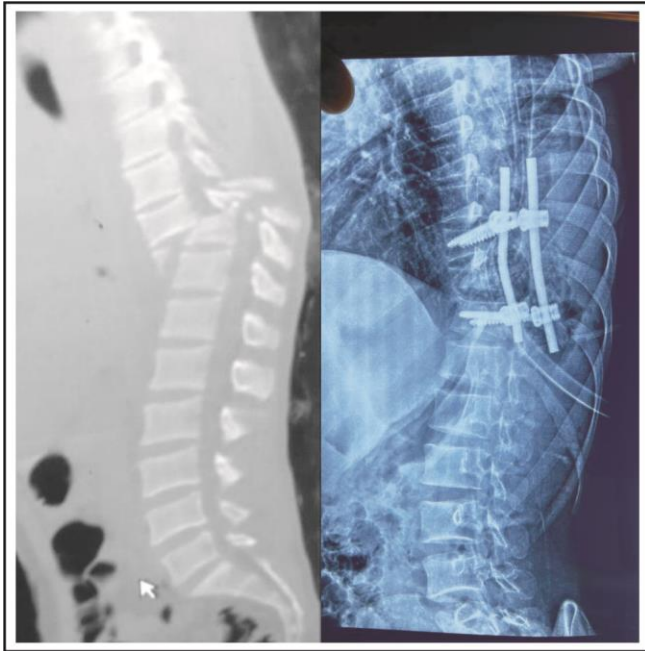


Figure 1 (Left): D10 vertebral fracture (pre-operative).
Figure 2 (Right): D10 vertebral fracture (post-operative).
 (Images used with patients' permission).

DISCUSSION

We evaluated the clinical improvement in patients with thoracolumbar fractures who received transpedicular fixation in the post-operative period. Based on the observations drawn from the results, a considerable percentage (12 – 25%) of patients had improved after surgery. As the severity of the deficit decreased (Grade C, D, and E) improvement was seen. Khan et al,¹ presented the surgical results of thoracolumbar fractures treated using short-segment pedicle instrumentation. Although long-term follow-up evaluation is required, the findings of the short-term follow-up indicate a favorable outcome for short-segment instrumentation. There was no increase in neurological deficiency in any of the patients. The majority of the patients improved to the following grade. Screw failure occurred in eight patients, bedsores in sixteen, and deep vein thrombosis in three. In five of the cases, the screw was misplaced. In eight cases, the wound became infected.¹

Treatment of thoracolumbar fractures with transpedicular intervertebral bone graft and pedicle screw fixation in injured vertebrae is effective in terms of reconstructing vertebral body height, increasing the stability of the injured vertebrae's anterior and middle columns, and preventing height loss and instrumentation loosening.¹³ Single-stage posterior vertebral column excision and internal fixation for old thoracolumbar fracture-dislocations is an effective therapy that allows for full decompression, pain alleviation, deformity correction, and spinal stability restoration. After surgery, all patients had bone fusion and relief from local back discomfort. According to a comprehensive evaluation of 25 studies, the majority of patients experienced less back discomfort after surgery, and the postoperative kyphotic angle was considerably lower than the preoperative kyphotic angle.¹⁴ Wang et al,¹⁵ also reported that the treatment of thoracolumbar fractures with single-segment pedicle screw fixation through the gap of paraspinal muscles may successfully recover the height of the vertebral body, rectify posterior salient, and minimize the fixed segment under the premise of rigorous regulating surgery reasons. When compared to the typical operating approach of double-segment pedicle screw fixation by paraspinal muscle stripping, it may reduce the operation wound and bleed, as well as diminish lumbar and back discomfort. And the most current clinical impact has been met.¹⁵

The use of posterior pedicle screws to treat thoracolumbar burst fractures has grown in popularity. However, it is uncertain if extra segment fixation may enhance clinical and radiological results. The findings of a meta-analysis revealed that when a thoracolumbar burst fracture was treated with posterior pedicle screw fixation, fixing extension was not required. More high-quality randomized controlled studies are still required in the future.¹⁶ In the hands of the greatest spine surgeons, the literature demonstrates a significant incidence of pedicle

screw misplacement but modest clinical consequences. The notion of appropriate screw placements and outcome categorization improves the correlation of pedicle screw evaluation findings with clinical outcomes.¹⁷ The vast majority of thoracolumbar spine fractures are unstable and frequently linked with neurological dysfunction. Because of technological advancements, these fractures are now more commonly handled surgically. Short segment trans-pedicle posterior fixation is beneficial not only for fracture stabilization and anatomical restoration but also for retaining the same over time with good functional results.¹⁸

In the absence of posterior element integrity, transpedicular screw fixation may provide improved three-column control. Findings show that transpedicular instrumentation is a safe and successful treatment option for unstable thoracic spinal injuries with a proper preoperative radiographic evaluation of the pedicular size and orientation.¹⁹ The use of cervical transpedicular screws resulted in a fairly secure fixation. However, there is still a danger of injuring nerve roots or the vertebral artery when using innovative procedures such as percutaneous screw application or computerized image guidance. This treatment should only be used on carefully selected patients with obvious indications, as well as by highly trained spine surgeons.²⁰

Posterior decompression with transpedicular instrumentation may be an alternate therapy option for individuals with less-involved spinal TB, particularly those in the early stages of bone degradation or with minimal kyphosis.²¹ The advancement in the surgical treatment of thoracolumbar fractures will assist spinal surgeons in determining the essential operation that will benefit the patients. To treat the fracture, the most appropriate and effective surgical procedure with the least amount of damage should be chosen. The benefits of non-fusion surgical therapy are currently being researched

²². Yang et al. reported that the pedicle fixators can restore and repair thoracolumbar fractures, and autograft and allograft bone transplantation is a safe, dependable, and successful procedure.²³

CONCLUSION & RECOMMENDATION

Surgery resulted in better clinical outcomes in a significant number of patients. ASIA Grades A and B should also be operated on early for greater clinical improvement. Transpedicular fixation is a simple, safe, and successful method. Without problems, patients demonstrated adequate synostosis and effective healing in virtual anatomic alignment. A long-term follow-up assessment is also required.

Limitation

A sample size of 34 is insufficient to draw a more profound conclusion and therefore, more research in this regard is needed.

REFERENCES

1. Khan AA, Khanzada K, Ayub S, Ali M. Surgical outcome of transpedicular fixation in thoracolumbar fractures. *J Ayub Med Coll Abbottabad*, 2008; 20 (4): 104-7.
2. Jeffrey WP, Joel RL, Eldin EK, Robert WG. Successful Short-Segment Instrumentation and Fusion for Thoracolumbar Spine Fractures A Consecutive 4 1/2-Year Series. *Spine*, 2000; 25: 1157-69.
3. Singh R, Rohilla RK, Kamboj K, Magu NK, Kaur K. Outcome of pedicle screw fixation and monosegmental fusion in patients with fresh thoracolumbar fractures. *Asian Spine Journal*, 2014; 8 (3): 298.
4. Kothe R, Panjabi MM, Liu W. Multidirectional instability of the thoracic spine due to iatrogenic pedicle injuries during transpedicular fixation: a biomechanical investigation. *Spine*, 1997; 15; 22 (16): 1836-42.
5. Roy-Camille R, Saillant G, Salgado V. Osteogenesis of thoracolumbar spine fractures with metal plates

- screwed through the vertebral pedicle. *Reconstr Surg Traumatol*. 1976; 15: 2–16.
6. Dorr LD, Harvey JP, Nickel VL. Clinical review of the early stability of spine injuries. *Spine*, 1982; 7: 545–53.
 7. Been HD, Bouma GJ. Comparison of two types of surgery for thoraco-lumbar burst fractures: combined anterior and posterior stabilisation vs. posterior instrumentation only. *Acta Neurochirurgica*. 1999; 141 (4): 349-57.
 8. Bradford DS, Akbarnia BA, Winter RB, Seljeskog EL. Surgical stabilization of fracture and fracture dislocations of the thoracic spine. *Spine*, 1977; 2 (3): 185-96.
 9. Frankel HL, Hancock DO, Hyslop G, Melzak J, Michaelis LS, Ungar GH, Vernon JD, Walsh JJ. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia. *Spinal Cord*, 1969; 7 (3): 179-92.
 10. Hashem S, Abdelbar A, Ibrahim H, Habib MA, Abdel-Monem A, Hamdy H. Review of Device and Operator Related Complications of Transpedicular Screw Fixation for the Thoracic and Lumbar Regions. *Egyptian Journal of Neurology, Psychiatry & Neurosurgery*, 2012; 49 (4).
 11. American Spinal Injury Association. Worksheet International standards for neurological classification of spinal cord injury (ISNCSCI); Revised version November 2015. [Internet] Available from: <http://asia-spinalinjury.org/information/downloads/>. Accessed March 2022.
 12. Han W, Zhong-li G, Jin-Cheng W, Ying-Pu L, Peng X, Rui J, Jun W. Pedicle screw placement in the thoracic spine: a comparison study of computer-assisted navigation and conventional techniques. *Orthopedics*, 2010; 33 (8).
 13. Li Q, Liu Y, Chu Z, Chen J, Chen M. Treatment of thoracolumbar fractures with transpedicular intervertebral bone graft and pedicle screws fixation in injured vertebrae. *Zhongguo Xiufu Chong Jian waike za zhi= Zhongguo Xiufu Chongjian Waike Zazhi = Chinese Journal of Reparative and Reconstructive Surgery*, 2011; 25 (8): 956-9.
 14. Tang HZ, Xu H, Yao XD, Lin SQ. Single-stage posterior vertebral column resection and internal fixation for old fracture–dislocations of thoracolumbar spine: a case series and systematic review. *European Spine Journal*, 2016; 25 (8): 2497-513.
 15. Wang RY, Hua YJ, Chen JH, Chai JL, Shao LF, Zhao JF. Single-segment pedicle screw fixation for the treatment of thoracolumbar fractures through the gap of paravertebral muscles. *Zhongguogu Shang = China Journal of Orthopaedics and Traumatology*, 2012; 25 (1): 42-6.
 16. Aly TA. Short segment versus long segment pedicle screws fixation in management of thoracolumbar burst fractures: meta-analysis. *Asian Spine Journal*, 2017; 11 (1): 150.
 17. Upendra BN, Meena D, Chowdhury B, Ahmad A, Jayaswal A. Outcome-based classification for assessment of thoracic pedicular screw placement. *Spine*, 2008; 33 (4): 384-90.
 18. Khare S, Sharma V. Surgical outcome of posterior short segment trans-pedicle screw fixation for thoracolumbar fractures. *Journal of Orthopaedics*, 2013; 10 (4): 162-7.
 19. Yue JJ, Sossan A, Selgrath C, Deutsch LS, Wilkens K, Testaiuti M, Gabriel JP. The treatment of unstable thoracic spine fractures with transpedicular screw instrumentation: a 3-year consecutive series. *Spine*, 2002 15; 27 (24): 2782-7.
 20. Kast E, Mohr K, Richter HP, Börm W. Complications of transpedicular screw fixation in the cervical spine. *European Spine Journal*, 2006; 15 (3): 327-34.
 21. Lee SH, Sung JK, Park YM. Single-stage transpedicular decompression and posterior instrumentation in treatment of thoracic and thoracolumbar spinal tuberculosis: a retrospective case series. *Clinical Spine Surgery*, 2006; 19 (8): 595-602.
 22. Peng J, Xu J. Research progress in surgical treatment of thoracolumbar fracture. *Zhongguoxiu fu Chong Jian waike za zhi= Zhongguo Xiufu Chongjian Waike Zazhi = Chinese Journal of Reparative and Reconstructive Surgery*, 2009; 23 (12): 1506-9.
 23. Yang X, Huo H, Xiao Y, Xing W, Zhao Y, Fu Y. Pedicle screw fixation and allograft bone in posterior spinal fusion for treatment of thoracolumbar vertebral fractures. *Zhongguoxiu fu*

Chong Jian waike za zhi= Zhongguo Xiufu
Chongjian Waike Zazhi = Chinese Journal of

Reparative and Reconstructive Surgery, 2009; 23
(5): 520-3.

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.

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Mahmood Khan Kibzai	1. Study design and methodology.
2.	Muhammad Haroon	2. Paper writing, referencing, and data calculations.
3.	Muhammad Shoaib Kibzai	3. Data collection and calculations.
4.	Zeenat-un-Nisa	4. Analysis of data and interpretation of results etc.