



Research Article

Percutaneous Pedicle Screw Fixation in Thoracolumbar Fractures: A Clinical and Radiological Study

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ABSTRACT

Background: Thoracolumbar fractures account for a significant proportion of spinal injuries and commonly result from high-energy trauma such as road traffic accidents and falls from height. The thoracolumbar junction (T11–L2) is particularly vulnerable due to the biomechanical transition between the rigid thoracic spine and the mobile lumbar spine. Surgical stabilization is frequently required in unstable fractures to restore spinal alignment, prevent neurological deterioration, and facilitate early mobilization.

Methods: This prospective study evaluated 20 patients with thoracolumbar fractures managed with percutaneous pedicle screw fixation. Patients were assessed clinically and radiologically. Parameters studied included mode of injury, associated injuries, interval between trauma and surgery, and radiological outcomes such as anterior vertebral body compression (ABC). Radiological evaluation was performed preoperatively, immediately postoperatively, and during follow-up.

Results: The mean preoperative anterior vertebral body compression (ABC) was $32.6 \pm 6.92\%$, which improved to $22.35 \pm 5.17\%$ postoperatively and was $24 \pm 4.83\%$ at final follow-up. The majority of fractures occurred at the thoracolumbar junction and were predominantly caused by road traffic accidents and falls from height. Percutaneous pedicle screw fixation resulted in satisfactory restoration of vertebral body height and spinal alignment with minimal surgical morbidity.

Conclusion: Percutaneous pedicle screw fixation is an effective minimally invasive technique for stabilization of thoracolumbar fractures. It provides adequate fracture stabilization, satisfactory radiological correction, and favorable clinical outcomes while minimizing soft tissue damage and surgical complications.

Keywords: Thoracolumbar spine fractures, Percutaneous pedicle screw fixation, Spinal stabilization, Minimally invasive spine surgery, Thoracolumbar junction (T11–L2).

INTRODUCTION

Thoracolumbar spine injuries represent one of the most common forms of spinal trauma encountered in orthopaedic practice. With increasing urbanization, industrialization, and motorization, the incidence of high-energy trauma has increased significantly, resulting in a higher prevalence of thoracolumbar fractures.

The thoracolumbar junction, particularly between T11 and L2, is especially susceptible to injury due to the transition from the relatively rigid thoracic spine to the more mobile lumbar spine. This region experiences significant biomechanical stress, making it a frequent site for fractures following high-energy trauma such as road traffic accidents and falls from height.

Management of thoracolumbar fractures depends on several factors including fracture morphology, neurological status, and spinal stability. While stable fractures may be treated conservatively, unstable fractures often require surgical stabilization to restore spinal alignment, maintain stability, and allow early mobilization.

Conventional open posterior stabilization using pedicle screw instrumentation has long been considered the standard surgical approach. However, open procedures involve extensive muscle dissection, increased blood loss, postoperative pain, and prolonged recovery.

Minimally invasive spinal techniques have been developed to overcome these limitations. Percutaneous pedicle screw fixation allows stabilization of the spine through smaller incisions with minimal muscle damage, reduced blood loss, shorter hospital stay, and faster recovery.

The present study aims to evaluate the clinical and radiological outcomes of percutaneous pedicle screw fixation in thoracolumbar fractures.

MATERIALS AND METHODS

This prospective clinical study was conducted on 20 patients with thoracolumbar fractures who were treated with percutaneous pedicle screw fixation.

Inclusion Criteria

- Patients with thoracolumbar fractures between T11 and L2
- Patients with unstable fractures requiring surgical stabilization
- Age above 18 years
- Patients willing to participate in follow-up

Exclusion Criteria

- Pathological fractures
- Previous spinal surgery
- Patients medically unfit for surgery
- Patients unwilling for follow-up

Preoperative Evaluation: All patients underwent:

- Detailed clinical examination
- Neurological assessment
- Radiological evaluation including:
 - X-ray spine
 - CT scan

Radiological parameters assessed included:

- Anterior Vertebral Body Compression (ABC)
- Vertebral height restoration
- Fracture morphology

Surgical Technique: All patients were operated under general anesthesia in the prone position on a radiolucent operating table.

The procedure involved:

1. Localization of pedicles using fluoroscopy.
2. Small skin incisions made over the pedicle entry points.
3. Guide wires inserted percutaneously into the pedicles under fluoroscopic guidance.
4. Sequential dilation performed.
5. Cannulated pedicle screws inserted over guide wires.
6. Rods introduced and fixation completed.



Pre-operative MRI.



Intra-op



Pre-operative XR



3 Months follow up



Six months follow up

This minimally invasive approach reduces muscle stripping and soft tissue damage.

Postoperative Care

Patients were mobilized early with spinal support. Postoperative radiographs were obtained to assess implant placement and fracture reduction.

Follow-up evaluation included:

- Clinical assessment
- Radiological evaluation
- Measurement of anterior vertebral body compression

RESULTS

The study included 20 patients with thoracolumbar fractures treated with percutaneous pedicle screw fixation.

Mode of Injury: The most common mechanisms of injury were:

- Road traffic accidents
- Falls from height

These accounted for the majority of thoracolumbar injuries in the study population.

Level of Injury: Most fractures occurred at the thoracolumbar junction (T11–L2), which corresponds with the known biomechanical vulnerability of this region.

Radiological Outcomes: The mean Anterior Vertebral Body Compression (ABC) was:

Stage	Mean ABC
Preoperative	32.6 ± 6.92 %
Postoperative	22.35 ± 5.17 %
Final follow-up	24 ± 4.83 %

These findings demonstrate significant improvement in vertebral body height after surgical stabilization.

Surgical Outcomes: Percutaneous fixation showed:

- Reduced intraoperative blood loss
- Minimal muscle damage
- Early postoperative mobilization
- Good fracture stabilization

No major intraoperative complications were observed.

DISCUSSION

Thoracolumbar fractures account for a substantial proportion of spinal injuries, particularly following high-energy trauma. The thoracolumbar junction represents a biomechanical transition zone and therefore is highly susceptible to injury.

Traditional open posterior fixation has been widely used for stabilization of these fractures; however, it is associated with several drawbacks including extensive muscle dissection, increased blood loss, and postoperative pain.

Minimally invasive spinal surgery techniques have gained popularity in recent years. Percutaneous pedicle screw fixation provides spinal stabilization while minimizing soft tissue damage. Several studies have demonstrated that this technique leads to reduced postoperative pain, shorter hospital stay, and faster rehabilitation.

Foley and Gupta first described percutaneous pedicle screw fixation as a minimally invasive technique that provides effective spinal stabilization while reducing surgical morbidity.

In the present study, the mean anterior vertebral body compression improved significantly after surgery, indicating effective restoration of vertebral body height. These findings are consistent with previous studies that have demonstrated satisfactory radiological correction using percutaneous fixation techniques.

Wild et al. reported favorable long-term outcomes following minimally invasive stabilization of thoracolumbar fractures. Similarly, Wang et al. demonstrated that percutaneous pedicle screw fixation provides comparable stabilization to open techniques while reducing operative trauma.

The minimally invasive nature of this procedure also allows earlier mobilization, which plays a crucial role in reducing complications such as deep vein thrombosis, pulmonary complications, and prolonged immobilization.

However, the technique requires adequate surgical expertise and fluoroscopic guidance to ensure accurate screw placement.

Limitations of the present study include:

- Small sample size
- Limited follow-up period
- Lack of comparison with open fixation techniques

Further large-scale studies with longer follow-up are required to evaluate long-term functional outcomes.

CONCLUSION

Percutaneous pedicle screw fixation is an effective minimally invasive technique for the management of thoracolumbar fractures. It provides:

- Adequate spinal stabilization
- Restoration of vertebral body height
- Reduced soft tissue damage
- Early mobilization
- Favourable radiological outcomes

The technique represents a reliable alternative to conventional open posterior fixation in appropriately selected patients.

REFERENCES

1. Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. *Spine*. 1983.
2. McAfee PC, Yuan HA, Fredrickson BE. The value of computed tomography in thoracolumbar fractures.
3. Holdsworth F. Fractures, dislocations, and fracture-dislocations of the spine.

4. Roy-Camille R. Internal fixation of the lumbar spine with pedicle screw plating.
5. Dick W, Kluger P, Magerl F, et al. A new device for internal fixation of thoracolumbar and lumbar spine fractures.
6. Magerl F, Aebi M, Gertzbein SD. Comprehensive classification of thoracic and lumbar injuries.
7. Vaccaro AR, Lehman RA. Thoracolumbar injury classification and severity score.
8. Parker JW, Lane JR. Successful short-segment instrumentation for thoracolumbar fractures.
9. Shen WJ, Liu TJ. Nonoperative treatment versus posterior fixation for thoracolumbar burst fractures.
10. Alanay A, Yazici M. Short-segment pedicle instrumentation.
11. Foley KT, Gupta SK. Percutaneous pedicle screw fixation.
12. Kim DY, Lee SH. Multifidus muscle injury after open vs percutaneous fixation.
13. Wang MY, Anderson DG. Minimally invasive posterior fixation.
14. Wild MH, Glees M. Minimally invasive stabilization of thoracolumbar fractures.
15. Grossbach AJ. Minimally invasive posterior stabilization.
16. Schizas C. Percutaneous pedicle screw fixation.
17. Dai LY. Posterior short segment fixation.
18. Korovessis P. Combined anterior and posterior stabilization.
19. Lee JK. Percutaneous pedicle screw fixation without fusion.
20. Wang H. Comparison of open vs percutaneous fixation.
21. Ni WF. Percutaneous pedicle screw fixation outcomes.
22. Deng ZQ. Clinical comparison of percutaneous fixation.
23. Phan K. Systematic review of percutaneous fixation.
24. Fan G. Outcomes of minimally invasive stabilization.
25. Mobbs RJ. Minimally invasive spinal surgery.
26. Vaccaro AR. Spine trauma classification.
27. Wood KB. Thoracolumbar fracture management.
28. McCormack T. Load sharing classification.
29. Gertzbein SD. Stability of spinal fractures.
30. Denis F. Spinal instability in thoracolumbar injuries