

Percutaneous Pedicle Screw Fixation for Neurologic Intact Thoracolumbar Burst Fractures

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ABSTRACT

Background: Thoracolumbar burst fractures are the most prevalent spinal injury. Nevertheless, the treatment of unstable burst fractures of thoracolumbar remains a topic of controversy, particularly for cases who do not have a neurologic deficit.

Objective: This study aimed to estimate the effectiveness of percutaneous fixation in thoracolumbar fractures.

Patients and methods thirty-six adult cases have been included in this investigation from January 2018 to December 2021. There were thirty-one males and five females. The age of admission varied from nineteen to fifty-eight years.

Results: All cases have been successfully treated with percutaneous minimal invasive techniques. The amount of blood that was lost during the operation ranged from fifty to one hundred fifty milliliters. The duration of the cases' stays in the hospital varied anywhere from three to nine days. All cases have been monitored for a duration of time that spanned from twelve to thirty months. The average kyphotic angle before operation was 6.8 to 33.5 degrees, and it was promptly enhanced following the operation, resulting in an average correction of deformity of 9.1 degrees. The kyphotic angle was 7.6 degrees at the final follow-up, with a range from 5.9 to 17.1 degrees. The average percentage of height of the vertebral body loss before operation was 42.2% (ranging from thirty-four to sixty-three percent), and it was promptly decreased to 8.3% (ranged from zero to 23.5 percent) following the operation. 10.2% was the percentage of loss of vertebral body height (VBH) that has been seen at the last monitoring, with the range being from zero percent to thirty-two percent.

Conclusion: For management of thoracolumbar, AO type, A3 fractures with a load-sharing score of six or lower, percutaneous fixation may serve as an alternative procedure.

Keywords: Burst fractures, Percutaneous fixation.

INTRODUCTION

Thoracolumbar burst fractures are the most prevalent spinal injury. Nevertheless, the treatment of unstable burst fractures of thoracolumbar remains a topic of controversy, particularly for cases who do not have a neurologic deficit. Although, nonsurgical treatment like bed rest, braces, or brace, has been described to result in favorable outcomes for these cases. The fact that treatment without surgery can be associated with certain late or early consequences, as late neurologic impairment, pressure sores, extended recumbency, and persistent kyphosis, is a fact that is widely acknowledged^(1, 2).

The utilization of surgical procedures in conjunction with improved surgical methods and implants has been shown to yield results that are satisfactory. When compared to the therapy of casting or bracing, surgical management is more reliable in terms of vertebral height, canal dimension and restoring sagittal alignment. Additionally, surgical management provides rapid spinal stability^(3, 4).

Between operative choices, posterior short segment pedicle instrumentation is the most commonly utilized for fractures of thoracolumbar all over the globe due to its three-column fixation⁽⁵⁾. Furthermore, the open posterior procedure with short-segment pedicle instrumentation is associated with relatively extensive exposures, which can lead to significant morbidity as a consequence of increased blood loss during the surgical procedure, increased rates of infection, and denervation or damage of the paraspinal muscles^(6, 7).

In recent years, spine surgery has seen a rise in the popularity of minimally invasive procedures, as percutaneous pedicle fixation of screw. Magerl^(8, 9) initially introduced the percutaneous lumbar pedicle screw fixation method in 1977 for the purpose of impermanent external fixation. Subsequently, certain authors described the percutaneous method for transient stabilization in cases with suspected segmental lumbar instability⁽¹⁰⁾. The utilization of pedicle screws for the purpose of internal fixation in low lumbar fusion was documented by Foley *et al*⁽¹¹⁾. Compared to open pedicle screw fixation. Kim *et al.*⁽¹²⁾ revealed that percutaneous fixation caused less injury to the paraspinal muscles.

PATIENTS AND METHODS

The inclusion criteria: Neurologically intact, aged from eighteen to sixty years, singular AO type A3 fracture of the thoracolumbar spine (T11-L2), time among trauma and operation being shorter than ten days.

Exclusion criteria: Cases with pathologic or osteoporotic fractures and those who had undergone prior operations at the fracture site.

Thirty-six adult cases have been included in the research from January 2018 to December 2021. There were thirty-one men and five women. The age of admission varied from nineteen to fifty-eight years. The fracture levels were as follows: four patients at T11, ten

patients at T12, fifteen patients at L1, and seven patients at L2 (Figure 1).



Figure (1): Lateral and anteroposterior X-ray of L2 fracture.

In eighteen cases, mechanism of injury was a fall from a height, while in twelve of cases, it was a motor vehicle accident. Prior to the procedure, plain x-ray images have been utilized in order to quantify the sagittal spinal curve, also known as the Cobb angle⁽¹³⁾, as well as the height of the vertebral body, also known as the VBH. These films comprised both supine lateral and AP views. Utilizing computerized tomography scans and reconstruction pictures, we were able to quantify the apposition of fragments of fracture as well as the quantity of comminution that occurred within the fractured vertebral body. For the aim of determining the sagittal curvature, the Cobb angle, which is the angle that exists among the superior endplate 1 level above the fracture and the inferior endplate 1 level below, has been applied. A calculation was then made to determine the percentage of loss of vertebral height.

Supine lateral and AP plain radiographs have been obtained immediately, six, twelve, and fourteen months following the surgery, as well as annually. The precision of screw placement in cases was determined through the use of computed tomography scans. We classified the degree of pedicle violation as follows: Minor (below

half of screw thread), moderate (Less than entire screw thread), and severe (Greater than diameter of screw). A meticulous analysis of these evaluations was conducted for all cases.

Ethical Consent: Authorization for the investigation was procured from the Academic and Ethical Committee of Helmeya Hospital. Each participant provided informed written consent for data collection prior to inclusion in the study. This research was meticulously conducted in strict alignment with the ethical standards delineated by the global Medical Association's Declaration of Helsinki concerning human subject investigation.

RESULTS

All cases have been successfully treated with percutaneous minimal invasive techniques. The duration of the operation varied from sixty-two to 117 minutes (Figure 2).

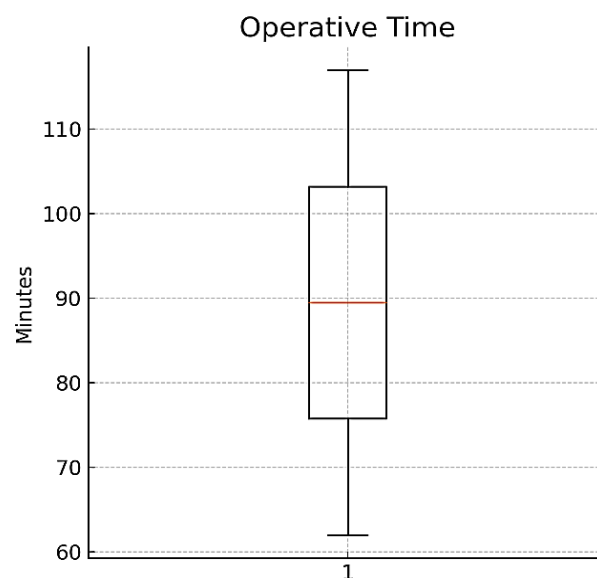


Figure (2): The range of operative time.

The amount of blood that was lost during the operation ranged from fifty to one hundred fifty milliliters. The duration of the cases' stays in the hospital varied anywhere from three to nine days. All cases have been monitored for a duration of time that spanned from twelve to thirty months.

The average kyphotic angle before operation was 6.8 to 33.5 degrees, and it was promptly enhanced following the operation, resulting in an average correction of deformity of 9.1 degrees. The kyphotic angle was 7.6 degrees at the final follow-up, with a range of 5.9 to 17.1 degrees (Figure 3).

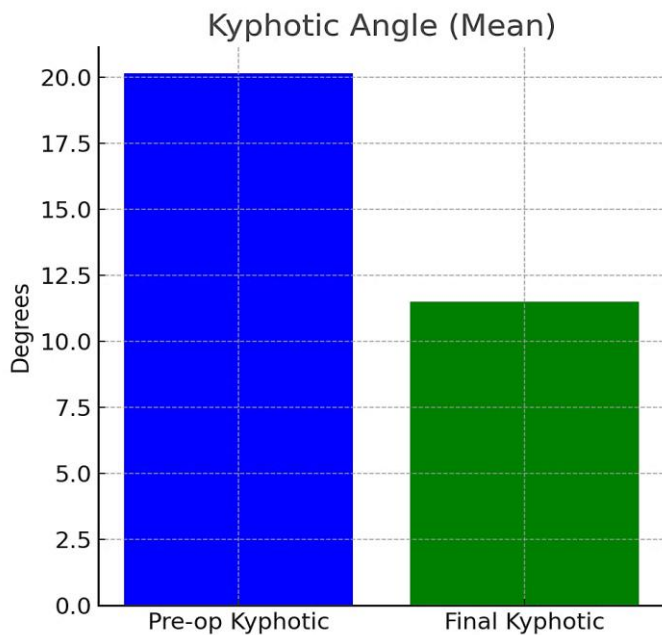


Figure (3): Difference in kyphotic angle.

The average percentage of height of the vertebral body loss before operation was 42.2% (ranged from thirty-four to sixty-three percent), and it was promptly decreased to 8.3% (ranged from zero to 23.5 percent) following the operation. 10.2% was the percentage of VBH loss that was seen at the last monitoring, with the range being from zero percent to thirty-two percent.

The Modified Macnab Criteria ⁽¹⁴⁾ have been utilized to assess the clinical result. Thirty-one of the thirty-six cases (86.1%) achieved a satisfactory result, with nineteen cases receiving outstanding and twelve receiving good results. Five cases received unsatisfactory results, all of which were fair. One case required occasional medication among those who received satisfactory outcomes. There was no change in the cases' neurological intact; however, one case did develop a superficial infection at the site of the incision, which was eventually healed. Despite the fact that one case experienced a loosening of the fastener, no breakage of implant happened.

DISCUSSION

Meanwhile **Roy-Camille et al.** ⁽¹⁵⁾ published their findings about the use of plates with pedicle screws for the treatment of fractures of thoracolumbar, posterior short-segmental pedicle fixation of screw has been an increasingly popular method for the management of fractures of thoracolumbar. In most cases, open posterior spine operation has been related to morbidity due to the approach, mostly because of the extensive para-spinal muscle stripping that occurs throughout the procedure. Conversely, minimally invasive methods, such as PPSF, significantly reduce iatrogenic injury to the para-spinal musculature. The research conducted by **Kim et al.** ⁽¹²⁾ showed that PPSF resulted in less injury to the para-spinal muscles compared to open pedicle

screw fixation and had a good impact on the performance of the trunk muscles after surgery.

When it comes to the treatment of degenerative lumbar disorders, percutaneous fixation techniques are frequently applied as a supplementary method of fixation in combination with fusion of anterior lumbar interbody or minimally invasive posterior ^(16,17).

The misplacement occurrence (6.7%) was lower than that of open screw insertions (eight to forty percent) ⁽¹⁸⁾ and was comparable to percutaneous screw insertions (6.6 percent) assisted with conventional fluoroscopes, as documented by **Wiesner et al.** ⁽¹⁹⁾. Moreover, most of screws that have been misplaced resulted in a small pedicle violation, and every single screw that was misplaced did not generate any clinical symptoms ⁽²⁰⁾.

Despite the fact that three-dimensional fluoroscopy has contributed to the enhancement of percutaneous fixation accuracy, we are of the opinion that conventional fluoroscopy is a dependable method for insertion of percutaneous thoracolumbar pedicle screws ⁽²¹⁾. When it comes to the treatment of thoracolumbar burst fractures, nevertheless, a number of authors advocate for the utilization of short-segment pedicle instrumentation in conjunction with either transpedicular or posterolateral bone grafting ⁽²²⁾. Fusions are also a source of ongoing controversy, particularly with regard to their importance and trustworthiness ⁽¹⁶⁾. **Sanderson et al.** ⁽²³⁾ showed that unstable burst fractures of thoracolumbar can be managed adequately with short-segment pedicle screw fixation in absence of fusion. This was illustrated by the fact that the fractures were able to be treated. In a randomized and prospective research that compared short-segment instrumentation with and without fusion, the non-fusion group exhibited superior parameters before operation. The radiologic and functional evaluation of findings were virtually identical among the fusion and non-fusion groups ⁽²⁴⁾.

In the same line, our percutaneous procedures didn't involve bone grafting, and the clinical outcomes were comparable to those of previous studies that utilized a variety of fusions. We underscored the importance of the recovery of fractured vertebral body to preserve the motion and stability of injured segment. Our research demonstrated that percutaneous fixation without any fusion might produce satisfactory outcomes for fractures AO type A3 with a load-sharing score of six or below.

However, percutaneous fixation without fusion is not an effective treatment for severe comminuted fractures of thoracolumbar with load-sharing points of seven or greater ^(13,25). Instead, the anterior column support that is provided by anterior reconstruction surgery is of much greater significance ⁽²⁶⁾. The U-shaped screw head simplifies insertion and securing of the rod, while the cannulated pedicle screws, which are inserted and a needle, improve the precision of placement of screw. The thread structure can be rotated

to achieve extra distraction or compression, and the angled rod is capable of inducing lordosis and achieving near anatomic reduction of the thoracolumbar spine. The findings of this series demonstrated the advantages of percutaneous instrumentation in terms of its ability to reduce burst fractures.

CONCLUSION

In summary, percutaneous fixation may serve as an alternative therapy for thoracolumbar, AO type, A3 fractures with a load-sharing score of six or lower. Achieving satisfactory outcomes requires careful case choice, and a combination of percutaneous fixation and a minimally invasive anterior operation may be required for the therapy of severe comminuted vertebral body fractures that require rebuilding of the anterior column. It is possible that additional evidence could be produced by a prospective, randomized control test indicating that percutaneous fixation is preferable to open procedures under the circumstances of a prolonged investigation.

Financial support and sponsorship: Nil.

Conflict of interest: None.

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