



PROSPECTIVE STUDY OF MANAGEMENT OF FRACTURES OF THORACO-LUMBAR SPINE WITH PEDICLE SCREW FIXATION

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ABSTRACT

Background: Spinal cord injuries and fractures of the thoracolumbar spine are common in modern orthopedic practice, leading to significant morbidity, disability, and mortality if not properly diagnosed and managed. Surgical stabilization of the spine has been shown to prevent further damage to the neural tissue and improve neurological outcomes. This study aimed to evaluate the effectiveness of posterior stabilization with pedicle screw-rod instrumentation in the treatment of unstable thoracolumbar spine fractures. **Methodology:** The prospective study was conducted on 20 patients with post-traumatic thoracolumbar spine fractures treated surgically between August 2019 and September 2021. Patients were assessed for clinical and neurological status, and various imaging modalities such as X-rays, CT scans, and MRI were used to determine the extent and nature of the injuries. Posterior stabilization with pedicle screw-rod instrumentation was performed in all cases. **Results:** The participants in the study ranged in age from 18 to 45 years old, including 16 men and 4 women. The most frequent causes of injury were road traffic accidents and falls from a height. The lumbar spine was more frequently affected than the thoracic spine. Pre-operative steroid administration was done in 14 cases. Neurological assessment using the ASIA scoring system showed improvement in neurological function postoperatively. Radiological assessments, including regional kyphotic angle, anterior wedge angle, and sagittal index, showed significant improvement at different follow-up intervals. **Conclusion:** Posterior stabilization with pedicle screw-rod instrumentation proved to be an effective treatment for thoracolumbar spine fractures. The procedure restored near-normal anatomy and achieved favorable radiological outcomes in terms of vertebral height and alignment. It also led to improved neurological function, pain relief, early mobilization, and fewer complications associated with prolonged bed rest. The study supports the importance of early intervention for better prognosis in these cases.

KEYWORDS : Thoracolumbar spine fractures, pedicle screw-rod instrumentation, neurological improvement, radiological outcomes, early mobilization

INTRODUCTION

In modern orthopedic practice, spinal cord injuries and fractures are prevalent, and failure to diagnose or manage them can lead to significant morbidity, disability, and mortality. Among trauma patients, approximately 6% suffer from spinal fractures, with around 2.6% of these cases resulting in the spinal cord or nerve root-level neurological injuries.¹ While thoracolumbar spine fractures have a bimodal distribution, with maxima in young males due to high-velocity injuries and in the elderly population due to osteoporosis, cervical spine fractures are more common. Thoracolumbar spine injuries make up 30-60% of all spinal injuries, and the thoracolumbar junction (T12 to L2) is particularly susceptible to trauma, accounting for up to 60% of cases.² However, neurological damage is only present in 15-25% of thoracolumbar fractures.³

Historically, paralysis was considered incurable, and early treatment of thoracolumbar fractures involved bed rest for 8-12 weeks.⁴ However, this approach led to complications and required highly skilled personnel, making it challenging to implement in developing countries like India. Consequently, there arises a necessity for interventions that prioritize early mobilization and patient rehabilitation.⁵ The objectives of such interventions encompass reinstating the patient's functionality to the highest attainable level, averting additional harm to neural tissue, optimizing neurological recuperation, preserving or reinstating spinal alignment, and mitigating the decline in spinal mobility.

Surgical stabilization of the spinal column is essential to prevent further mechanical injury to the damaged cord tissue. Operative interventions, such as decompression, distraction,

and instrumentation, are intended to provide immediate stability to the spine, correct deformities, and optimize neurological improvement by relieving any residual impingement of neural elements. Posterior instrumentation, including pedicle screw-rod constructs and their modifications, is a safe and effective treatment for thoracolumbar fracture instability.⁶ Distraction instrumentation is typically used for axial loading and compression flexion-type injuries with intact posterior elements.⁷ Pedicle screw placement is preferred for its rigid stability, as the screw passes through the vertebral body's force nucleus, transmitting posterior forces through five anatomical structures (superior facet, inferior facet, lamina, pedicle, and transverse process) to the vertebral body.⁸

In this study, the aim was to evaluate the effectiveness of posterior stabilization with pedicle screw-rod instrumentation in the treatment of unstable thoracolumbar spine fractures. The researchers aimed to assess the restoration of near-normal anatomy, radiological outcomes in terms of vertebral height and alignment, improvement in neurological function, pain relief, early mobilization, and the occurrence of complications associated with prolonged bed rest. The study focused on patients with thoracic and lumbar spinal fractures and utilized the Denis work and pain scale as a spinal scoring system to evaluate clinical outcomes. The findings of this study contribute to the current knowledge base of thoracolumbar fractures and their treatment, particularly in optimizing neurological recovery and achieving disability-free lives for patients with these injuries.

METHODOLOGY

The prospective study was conducted on 20 patients with post-

traumatic dorsolumbar spine fractures at the Department of Orthopaedics of Indira Gandhi Government Medical College, Nagpur, between August 2019 and September 2021. The initial assessment of patients included obtaining a comprehensive history of the injury, and mode of injury, and conducting a thorough clinical and neurological examination to determine stability. Priorities focused on patient resuscitation and treatment of life-threatening injuries before stabilizing spinal injuries. Full neurological examinations, including sensation, motor function, and anal tone, were documented, and immediate spinal column protection was provided. Daily neurological examinations were conducted to monitor patient status.

Anteroposterior and lateral plain X-rays, CT scans, and MRI were used to identify all injuries and assess their severity and nature. The study utilized the DENIS and AO Magrel classifications to classify the level and type of fractures. Patients with unstable spines were informed about the advantages and disadvantages of surgery. The patients with thoracolumbar trauma fractures, unstable thoracolumbar fractures with or without neurological deficits, and incomplete neurological deficits were included. Patients unwilling or medically unfit for surgery, traumatic cervical fractures with traumatic quadriplegia, and patients over 60 years of age were excluded from the study.

The preoperative assessment encompassed performing anteroposterior and lateral plain X-rays to evaluate degeneration, instability, fracture pattern, severity, as well as canal compromise or deformity. Multiple measurements, including the COBBS angle, anterior wedge angle, and anterior vertebral height, were obtained using plain X-rays of the affected spine.

The surgical protocol consisted of posterior stabilization utilizing pedicle screw-rod instrumentation. The patient was positioned prone on a cushioned spinal operating table to mitigate venous stasis and intra-abdominal pressure. The posterior midline incision was made, exposing the posterior elements of the vertebrae. The pedicles were identified, and pedicle screws were inserted with the help of an image intensifier. A rod contouring template was used to shape the rods to match the natural curve of the spine. The rods were fixed in place, and a distraction extension assembly was created for the correction of the deformity. Adequate distraction was applied for correction, and thorough homeostasis was achieved before wound closure.

Postoperative treatment involved administering intravenous antibiotics for five days and switching to oral antibiotics until suture removal. Physiotherapy was initiated from the first day postoperatively, and patients were gradually mobilized with the use of a thoracolumbar belt. Patients were closely monitored for neurological improvement or deterioration. Routine postoperative X-rays were taken prior to discharge.

Follow-up examinations were conducted in the outpatient department every 4 weeks for six months. At each follow-up, clinical, radiological, and neurological assessments were performed to assess spinal stability. At the end of six months, patients were evaluated clinically using the Denis work and pain scale, and neurological and radiological assessments were conducted at different intervals, including admission, 12th week, 24th week, and 1 year postoperatively.

OBSERVATION AND RESULT

Table-1: Demographic distribution of patients.

Gender	No. of cases	Percentage
Male	16	80%
Female	4	20%
Total	20	100%

Age group (years)		
20-29	8	40%
30-39	4	20%
40-49	8	40%
Total	20	100%

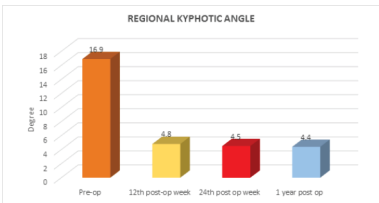
Among the total of 20 cases, 16 are male (making up 80% of the total) and 4 are female (constituting 20%). In terms of age distribution, there are 8 cases (40%) in the 20-29 age range, 4 cases (20%) in the 30-39 age range, and another 8 cases (40%) in the 40-49 age range, summing up to a total of 20 cases

Table-2: Distribution of level of vertebra and mode of injury.

Mode of injury	No. of cases	Percentage
FALL FROM HEIGHT	10	50%
RTA	9	45%
OTHER	1	5%
TOTAL	20	100%

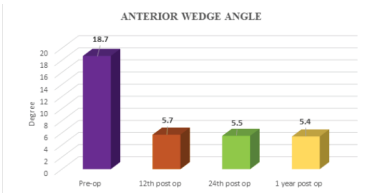
VERTEBRA		
THORACIC	8	40%
LUMBAR	12	60%
TOTAL	20	100%

Investigated herein are the patterns of injury occurrence, delineated by distinct modes of injury and vertebral segments affected. Among the total dataset of 20 cases, a preeminent 50% emanated from 'FALL FROM HEIGHT', followed closely by 45% attributed to 'RTA' (Road Traffic Accidents), while an incidental 5% resulted from 'OTHER' sources. In considering the vertebral involvement, 40% of the cases exhibited injuries within the 'THORACIC' region, whereas the 'LUMBAR' region accounted for the remaining 60%.



Graph-1: Regional Kyphotic Angle in Pre-operative and Post-operative.

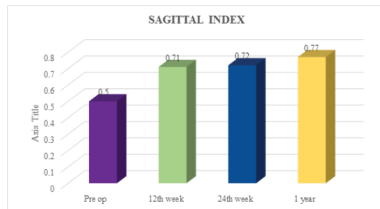
Before the surgical intervention (pre-op), the angle was recorded as 16.9 degrees. Successive evaluations then unveiled a progressive shift in spinal alignment. By the 12th week post-surgery, a substantial reduction was observed, with the angle reaching 4.8 degrees—a clear indication of significant correction. This encouraging pattern persisted, substantiated by a reading of 4.5 degrees at the 24th week post-op. Remarkably, this favorable trajectory extended throughout the entire year after the operation, as demonstrated by the angle measuring 4.4 degrees.



Graph-2: Anterior Wedge Angle After Post-operative.

Prior to the commencement of surgical intervention (pre-op), the anterior wedge angle was measured at 18.7 degrees,

reflecting the baseline condition. Subsequent assessments illuminated a marked paradigm shift in angular measurements, attesting to the efficacy of the medical intervention. In the 12th week following the surgical procedure, a substantial decrement in the angle was observed, quantifying at 5.7 degrees—a salient indicator of notable restorative advancement. This trajectory was consistently reinforced through subsequent measurements, with the 24th-week post-operative measurement yielding an angle of 5.5 degrees. Impressively, this positive vector of progress persisted over the entire year post-operation, substantiated by an angular reading of 5.4 degrees.



Graph-3: Classification of Sagittal Index After Post-operative.

Table-3: Distribution of Denis Pain Scale.

SCALE	1 YEAR POST OP	PERCENTAGE
P1	13	65%
P2	04	20%
P3	02	10%
P4	01	05%
P5	00	00%

Outlined here is an evaluation of patient outcomes based on a scale one year after their respective surgeries, depicted across different categories. Among the observed cases, P1 demonstrates a prominent recovery rate of 65%, followed by P2 at 20%. P3 and P4 exhibit more moderate improvements at 10% and 5% respectively. Notably, P5 illustrates no perceptible advancement, resulting in a 0% progression rate within the specified timeframe.

DISCUSSION

The study focused on the management of post-traumatic dorsolumbar spine fractures using posterior stabilization with pedicle screw-rod instrumentation. The goal was to attain the restoration of utmost functionality, forestall additional harm to neural tissues, optimize neurological recuperation, sustain or reinstate spinal alignment, and curtail the diminishment of spinal mobility.

Comparing the average age of patients in this study (31.5 years) with other studies, it falls within the range reported by Farrokhi et al⁸ (34 years) and RKI Ragab et al⁹ (37.2 years). The study had a higher percentage of male patients (80%) compared to other studies by Tian et al¹⁰ (70.4%) and Farrokhi et al⁸ (72.5%).

The prevailing mechanism of injury in this investigation was falls from height (50%), which was comparable to the findings of Tian et al¹⁰ (59.3%) and Farrokhi et al⁸ (60.5%).

Regarding the level of vertebral fracture, the lumbar region was more commonly affected (60%) in this study, consistent with the findings of Farrokhi et al⁸ (65%) and Tian et al¹⁰ (69.5%).

The ASIA scoring system was used in terms of neurological status at 1 year of follow-up. In this study, 35% of patients achieved Grade E, 30% Grade D, 15% Grade C, 10% Grade B, and 10% Grade A. Comparing this with other studies, RKI Ragab et al⁹ reported 41.2% Grade E, Farrokhi et al⁸ had 79% Grade E, and Tian et al¹⁰ had 81.5% Grade E.

The radiological outcome was assessed using parameters

like kyphotic angle, sagittal index, and anterior vertebral body compression angle. In this study, the kyphotic angle decreased from 16.9 pre-op to 4.8 post-op and 1-year post-op. The sagittal index improved from 0.51 pre-op to 0.76 post-op. Comparing this with other studies, Huang et al¹¹ reported a kyphotic angle decrease from 9.63 pre-op to 2.5 post-op and 1-year post-op, and Kim et al¹² had a kyphotic angle decrease from 19.7 pre-op to 5.5 post-op and 8.2 at 1 year. Yung & Thag et al¹³ reported a sagittal index increase from 0.68 pre-op to 0.79 post-op.

Overall, the study demonstrates that posterior stabilization with pedicle screw-rod instrumentation is an effective method for managing thoracolumbar spine fractures, achieving satisfactory clinical and radiological outcomes. The results compare favorably with previous studies, showing similar or improved kyphotic angles and sagittal indices, indicating successful restoration of spinal alignment and stability.

CONCLUSION

In conclusion, posterior stabilization with pedicle screw-rod instrumentation is an excellent treatment option for thoracolumbar spine fractures. It effectively restores near-normal anatomy and demonstrates favorable radiological outcomes in terms of vertebral height, kyphotic angle, and anterior wedge angle. The procedure offers various advantages, including the restoration or preservation of neurological function, achieving a pain-free fracture site, enabling early mobilization, and reducing complications associated with prolonged bed rest.

The study found that complications directly related to pedicle screw-rod instrumentation, such as infection at the fracture site, pedicle screw breakage, pressure sores, and screw misplacement, were comparable to those reported in other studies. Early intervention was shown to be beneficial for better prognosis in managing thoracolumbar fractures.

However, the study has certain limitations. It was a prospective study without a comparative group to validate the value of pedicle screws. Additionally, a standard sample size and sampling technique were not utilized. Despite these limitations, the study contributes valuable insights to the current knowledge base on the treatment of thoracolumbar fractures, emphasizing the effectiveness and advantages of posterior stabilization with pedicle screw-rod instrumentation.

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