



## Short Segment Fixation With Pedicle Screw At The Fracture Level For Unstable Thoracolumbar Fracture

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### Abstract

**Aim:** To evaluate the short-term surgical and functional outcome of posterior short segment fixation with implanting pedicle screw in the fractured level (short same-segment fixation) for treatment of recent single-level traumatic thoracolumbar fracture.

**Patients and methods:** 25 cases with unstable thoracolumbar fracture were treated with short segment fixation with fracture level pedicle screw at orthopaedic department, S.M.S Medical College, Jaipur from January 2018 to december 2020 were included who fulfilled the inclusion criteria after taking informed written consent.

**Results:** In final grading of outcome as per evaluation with Modified MacNab criteria, in the open short segment injury level pedicle screw fixation group, 11 patient had excellent result 12 had Good result, & 2 had fair outcome. Mean operative time was about 140 min with mean intraoperative blood loss of 370 ml, no intraoperative complications were encountered, but four patients (16%) developed postoperative wound infection that responded to conservative treatment

**Conclusion:** Short-segment pedicle screw fixation that includes the fractured vertebra achieved a reduction in unstable TL injuries and allowed for good correction of segmental kyphosis, vertebral wedging, and vertebral height loss. In addition, using this approach reduced the number of motion segments sacrificed in the fusion by long-segment fixation.

**Keywords:** Short segment fixation, Unstable thoracolumbar fracture, Pedicle screw

### Introduction

The thoracolumbar (TL) region of the spine ranges, by definition, from T11 to L2 inclusively, and nearly 60%–70% of all traumatic spinal fractures occur in the TL region. Biomechanical studies have demonstrated that in the upright position, 80%–90% of the axial compression force is absorbed by the anterior part of the spine body and intervertebral disc, whereas the posterior articular facets absorb the remaining 10%–20%<sup>(1)</sup>. Controversy exists about the best treatment of unstable TL burst fractures. Conservative treatment is usually the method of

choice if there is little kyphotic deformity, no neurological deficit, or no unstable fracture pattern. Kyphosis correction and canal decompression in case of a neurological deficit are recognized treatment objectives, and surgical strategies have been proposed<sup>(2)</sup>.

Surgical treatment of spine fractures aims to achieve bony union and restore spinal anatomy. A number of techniques have been described for the management of spinal fractures. Surgical treatment of spine fractures may associate, as needed, decompression, reduction, and graft and/or internal fixation, using a

posterior, anterior, or combined approach<sup>(3)</sup>. Approach for surgical correction is still a point of debate; anterior, posterior, or combined anterior and posterior procedures have been advocated and show various degrees of success<sup>(4)</sup>. On the basis of biomechanical considerations such as the load-sharing concept and tension-band principle, reconstruction of the anterior column with dorsal compression osteosynthesis instrumentation is the treatment of choice. A combined approach in one stage has the preference in comparison with a staged procedure<sup>(3)</sup>. Paraspinal approach is safe with the advantages of micro-trauma and less blood loss<sup>(5,6)</sup>.

Minimizing the number of vertebral levels involved in fusion of a spine fracture is a common goal of internal fixation. This is achievable by utilizing traditional short-segment posterior fixation; however, a 54% incidence of instrument failure or unfavorable clinical outcome was encountered with traditional short-segment posterior fixation<sup>(7)</sup>. Short-segment posterior fixation with pedicle fixation at the level of the fracture (short same-segment fixation) suggests biomechanical advantages toward maintenance of kyphosis correction and reducing failure rates<sup>(8)</sup>. The trans-pedicular short same-segment construct represents an attempt to rebuild the anterior column without the need for anterior strut graft or plate fixation, hence, avoiding extensive arthrodesis of the motion segments and limited surgery-related injury<sup>(9)</sup>.

The current prospective study aimed to evaluate the short-term surgical and functional outcome of posterior short-segment fixation with implanting pedicle screw in the fractured level (short same-segment fixation) for treatment of recent single-level traumatic thoracolumbar fracture.

### **Aims And Objectives**

To evaluate the short-term surgical and functional outcome of posterior short-segment fixation with implanting pedicle screw in the fractured level (short same-segment fixation) for treatment of recent single-level traumatic thoracolumbar fracture.

### **Material And Methods**

This randomized control intervention study was conducted on 25 cases admitted from Jan 2018 to december 2020 at Department of Orthopedics, S.M.S.

Hospital attached to S.M.S. Medical College, Jaipur (Rajasthan).

### **Inclusion Criteria-**

1. More than 18 years aged cases admitted through hospital with unstable dorsolumbar spinal fractures with duration of injury less than 7 days,
2. Closed Thoraco-lumbar vertebral (D11-L4) fracture with intact at least one Pedicle of fractured vertebrae determined by radiograph,
3. AO spine TLICS classification Type A1, A2, A3, A4, B1,
4. neurological injury as ASIA grade D and E only with normal general condition.

### **Exclusion Criteria**

1. Associated with other injury.
2. Patients unfit in anesthetic check up and not willing to take part in this study

### **Radiographic Study**

All patients underwent preoperative plain X-rays, computed tomography (CT), and magnetic resonance imaging (MRI) of the TL spine to evaluate the fracture. A fracture of any of the pedicles was not considered a contraindication to screw placement.

### **Surgical Technique**

A standard posterior midline approach was performed, and pedicle screws were inserted into the vertebra cephalad and placed caudal to the fracture. The screw size was chosen according to the size of vertebra (5.5–6.5 mm in diameter × 40–45 mm in length; rods were typically 5–6 mm), and the screws were inserted at a level above and a level below the injury and into the pedicles of the fractured vertebrae (intermediate screws) using a free-hand technique. The intermediate screw heads were left slightly proud to act as a push point and achieve a reduction of kyphosis. Intermediate screws were inserted in both pedicles of the fractured vertebra; however, if the pedicle walls were broken, no screws were inserted into that pedicle. We achieved complete reduction of kyphosis or restored vertebral height by rod overcontouring or distraction. In fractures with neurologic deficits or spinal canal compromise greater than 50%, a decompressive laminectomy was

performed. Anterior decompression surgery was not performed in any of the patients.

The degree of kyphosis correction and the position of the screws were assessed by postoperative radiographs. In patients with coexistent fractures at adjacent levels, additional vertebrae were fixed. All patients were periodically followed up with clinical and radiological evaluations. Radiographs were performed at 3, 6, 12 months after surgery.

**After surgery:**

Final results were assessed after a minimum follow up of 1 year like pain score, fractured anterior vertebral body height, fractured vertebrae posterior body height, angle of kyphosis /saggital cobb’s angle, Fractured vertebral body angle, Range of motion after fixation etc with complications if any.

The final outcome was measured using Modified MacNab criteria<sup>(10)</sup>

**Excellent:** No pain, No restriction of mobility return to normal work level of activity

**Good:** Occasional non-radicular pain relief of presenting symptoms; return to modified work

**Fair:** Some improved functional capacity ; still handicap and Unemployed

**Poor:** Continued objective symptom of root involvement, additional Operative intervention needed at the index level irrespective of Length of postoperative follow-up

**Observations And Result:**

In this series, most common type was wedge compression fractures, accounting for 56% of the cases. Next common type is burst fracture 44%.

**Table 1: Radiological outcome among study subjects**

<b>Saggital cobb’s angle</b>	Pre-op	26.76+_4.33
	Post-op	11.40+_2.41
	At 1 year	13.60+_2.63
	Changes	13.16+_3.47
<b>Fracture body angle</b>	Pre-op	15.32+_4.48
	Post-op	24.72+_4.05
	At 1 year	23.12+_4.02
	Changes	7.80+_1.58
<b>Anterior vertebral body height (cms)</b>	Pre-op	1.62+_0.28
	Post-op	2.45+_0.37
	At 1 year	2.24+_0.29
	Changes	0.62+_0.16
<b>Posterior vertebral body height (cms)</b>	Pre-op	2.50+_0.21
	Post-op	2.82+_0.14

	At 1 year	2.70+_0.14
	Changes	0.22+_0.16

**Table 2: Functional outcome among study subjects (using Modified MacNab criteria)**

<b>Excellent</b>	11
<b>Good</b>	12
<b>Poor/Fair</b>	2

**Discussion:**

Evaluation of spinal trauma-related data revealed that fall from height was the commonest mechanism of injury, and injury at thoracolumbar junction was encountered in 72.2% of cases and the majority of injuries were of type A. Similarly, Kalicinski *et al.*<sup>(11)</sup> reported that the most common causes of traumatic spinal injuries are falls from a height and road accidents and fractures occur most often at the thoracolumbar junction of the spine. Mean operative time was about 140 min with mean intraoperative blood loss of 370 ml, no intraoperative complications were encountered, but four patients(16%) developed postoperative wound infection that responded to conservative treatment. These data goes in hand with Feng *et al.*<sup>(12)</sup> who studied 16 severe thoracolumbar fracture dislocations treated with pedicle screw system via an entirely posterior approach and reported that mean operation time was treatment of thoracolumbar burst fractures. It provides the benefits of decreased involvement of motion segments than fixation with longer instrumentation.

However, many studies have reported loss of kyphosis correction and implant failure following short-segment fixation<sup>(13)</sup>. Increasing the fixation level is hypothesized to decrease the stress on each pedicle screw and so minimize the chance of failure. This may be achieved by use of long-segment constructs, but this requires fusing of multiple motion segments and larger incisions, with an increased risk of complications. An alternative method is to include screws at the level of the fracture<sup>(14)</sup>. In support of the short same-segment fixation, Mahar *et al.*<sup>(15)</sup>, in cadaveric study reported increased biomechanical stability of short-segment fixation with additional pedicle fixation at the level of fracture (short same-segment fixation). Subsequently, Guven *et al.*<sup>(16)</sup>

clinically showed increased stability and long-term maintenance with short same-segment fixation. Bolesta *et al.*<sup>(14)</sup> documented that a short segment construct with pedicle screws at the fracture site showed equivalent biomechanical stability compared with a conventional long-segment construct in any of the loading conditions. Also, Kanna *et al.*<sup>(17)</sup> found that reduction of unstable thoracolumbar injuries can be achieved and maintained with the use of short-segment pedicle screw fixation including the fractured vertebra and resulted insignificant improvement of preoperative kyphotic angle and wedge angle with significant improvement of anterior and posterior vertebral height.

The advantages of using pedicle screws to treat fractured vertebrae include the following: (i) it provides a good three-point fixation to reduce the suspension effect of the internal fixation system, (ii) it reduces the parallelogram effect to increase the stability, (iii) it avoids stretching the normal intervertebral disc, which is beneficial to the recovery of the vertebral fracture form, and (iv) it dispenses the stress of the pedicle screw connection. Therefore, conditional application of vertical stress screw fixation of fractured vertebrae enhances the stability of the posterior short-segment internal fixation system for thoracolumbar fractures and facilitates the correction of kyphosis and maintenance of the corrective effect<sup>(18)</sup>. Rehabilitation program was started once the patients’ status stabilized. All patients were protected by a Taylor brace for 3 months. Early ambulation and rehabilitation showed no deleterious effects on fracture fixation but allowed maintenance or even more improvement concerning low-back scoring and patients’ status at the end of follow-up. In line with these findings, Özlürk *et al.*<sup>(19)</sup> found that conservative treatment of stable

thoracolumbar burst fractures is widely accepted and early mobilization with customized brace appears to produce effective functional results despite loss of vertebral body height.

### Conclusion:

Short-segment pedicle screw fixation that includes the fractured vertebra achieved a reduction in unstable TL injuries and allowed for good correction of segmental kyphosis, vertebral wedging, and vertebral height loss. In addition, using this approach reduced the number of motion segments sacrificed in the fusion by long-segment fixation. The radiologic correction achieved is maintained even at the end of 1 year, which is reflected in good functional outcomes without additional complications. Thus, we recommend the insertion of screws into pedicles of the fractured TL vertebra when considering a short-segment posterior fixation.

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