

Outcome Assessment of Short Segment Added Injury Level Pedicle Screw Fixation and Conventional Short Segment Pedicle Screw Fixation in Thoraco-Lumbar Spine Fractures: A Comparative Study

Arnab Sinha¹, Santosh Kumar²

¹Senior Resident, Department of Orthopaedics, IGIMS, Patna, Bihar, India

²Professor and HOD, Department of Orthopaedics, IGIMS, Patna, Bihar, India

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Corresponding author: Dr. Arnab Sinha

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Abstract

Aim: The aim of the present study was to evaluate the outcome of short segment added injury level pedicle screw fixation and conventional short segment pedicle screw fixation in thoraco-lumbar spine fractures.

Methods: The present study was conducted at department of Orthopaedics, IGIMS, Patna, Bihar, India and 100 patients of thoracolumbar fractures mainly wedge compression & burst fracture without neurological deficits were selected in the study. The study was conducted from July 2016-June 2017. With 50 randomly selected cases in each group and were managed either by using CPSF or short segment injury level pedicle screw fixation (SSIPSF).

Results: In our study group of 100 patients (80 males & 20 females), most common mode of injury was fall from height (70%); RTA (20%); other causes (10%). Most common vertebra involved was L1 (50%), followed by T12 (40%), L2 (10%). In our series, Denis classification was used. Most common type was wedge compression fractures (60%) and burst fracture (40%). In SSIPSF the average pre-op Sagittal Cobb's angle was $25.65 \pm 4.32^\circ$, the immediate post-op $12.38 \pm 2.28^\circ$ & at final follow-up the correction was $11.19 \pm 1.18^\circ$. In CPSF the average pre-op Sagittal Cobb's angle was 28.02 ± 8.32 , the immediate post-op 16.34 ± 6.04 & at final follow-up the correction was 14.46 ± 2.58 . Fractured vertebral body angle in SSIPSF group the average pre-op fractured vertebral body angle was 15.45 ± 4.52 , the immediate post-op 25.75 ± 4.06 & at final follow-up the correction was 23.17 ± 4.08 .

Conclusion: In Open short segment Injury Level pedicle screw fixation (SSIPSF) inclusion of the fracture level into the construct offers a better kyphosis correction, in addition to no instrument failures, without additional complications had better and more rigid construct than conventional open short segment four pedicle screw fixation (CPSF).

Keywords: Thoracolumbar fractures, Pedicle screw, Conventional pedicle screw fixation (CPSF), Short segment injury level pedicle screw fixation (SSIPSF)

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Introduction

Improved knowledge of the anatomic, morphometric and biomechanical features of thoracolumbar (TL) vertebrae allowed progress and improvement of management

of unstable TL fractures that remained and still controversial. [1] 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. [2] 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. [3] 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. [4]

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. [5] 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. [6] Thoracolumbar fractures are the most common spinal injuries. [7] Although treatment remains controversial in some fracture types, posterior fixation is the most frequently used surgical technique to restore vertebral body height, correct kyphotic deformity, restore spinal stability and indirectly decompress the spinal canal. [8] A biomechanical study in 1994 by Dick et al. first reported the posterior short-segment fixation combined with two additional screws at the fracture level (6 screw construct). [9] Since this method was first introduced, the technique has

evolved. A series of biomechanical studies showed that the addition of screws at the fracture level could significantly increase spinal stability, provide stronger fixation and decrease the stress in the pedicle screws in the nonfractured vertebra. [10-12]

The aim of the present study was to evaluate the Outcome of short segment added injury level pedicle screw fixation and conventional short segment pedicle screw fixation in thoraco-lumbar spine fractures.

Materials and Methods

The present study was conducted at department of Orthopaedics, IGIMS, Patna, Bihar, India and 100 patients of thoracolumbar fractures mainly wedge compression & burst fracture without neurological deficits were selected in the study. The study was conducted from July 2016-June 2017. With 50 randomly selected cases in each group and were managed either by using CPSF or short segment injury level pedicle screw fixation (SSIPSF).

Inclusion criteria: All closed Thoracolumbar vertebral (D11-L4) fracture with intact both of Pedicle of fractured vertebrae, age > 18 years, Duration of injures 1 to 7 days, AO spine TLICS classification Type A1, A2, A3, A4, B1, as ASIA grade D and E only, General condition of patient normal, No/minor Associated injuries.

Exclusion criteria: Multilevel spinal injuries, Poor anesthetic or general risk patient, Thoracolumbar vertebral fracture with fracture pedicles, AO spine TLICS classification Type B2, B3, C, Neurological injury ASIA grade A,B,C.

Pre-op workup: Detailed history and physical examination. X-ray in A/P & lateral And MRI & CT scan was elicited in all cases. Surgical Technique CPSF: With help of image intensifier to determine appropriate site of skin incision. The

subcutaneous issues, erector spine muscle were infiltrated with adrenaline solution (1:500,000 dilution). A posterior midline approach was used. After superficial and deep dissection using an image in image intensifier, the pedicles of vertebrae above and below the involved segment were identified. Blunt Kirschner wires were inserted into the vertebral bodies through the pedicles and their position was confirmed fluoroscopically. Pedicle was probed in all four quadrants to be sure that a solid tube of bone exists. Screw up was introduced to cut the threads in created tract. A rod of the appropriate size was selected and contoured to maintain normal lumbar lordosis. A screw of appropriate length was selected. Reduction was achieved by distraction technique (ligamentotaxis) and assembly were fully tightened and then the wound was closed

in layers. Surgical Technique SSIPSF: it is almost same as CPSF the only difference is pedicle screw also inserted an injured pedicle too.

Post-operative protocol

Postoperative i.v. antibiotics were given for 5 day, taking care about bed sores, neurological status daily till discharge, Sitting with brace support was permitted as soon as second post op day. Follow up with Analysis: The analysis was made on, the intra-operative and post-operative volume of blood loss, operation time, and the anterior and posterior vertebral body height, vertebral body angle and kyphotic angle at preoperative and postoperative. Patients were followed up every month for first six and at one year.

Results

Table 1: Patient details

Gender	N%
Male	80 (80)
Female	20 (20)
Mode of injury	
Fall from height	140 (70)
RTA	40 (20)
Other	20 (10)
Vertebrae involved	
T12	80 (40)
L1	100 (50)
L2	20 (10)
Denis classification	
Wedge compression fractures	120 (60)
Burst fracture	80 (40)

In our study group of 100 patients (80 males & 20 females), most common mode of injury was fall from height (70%); RTA (20%); other causes (10%). Most common vertebra involved was L1 (50%), followed

by T12 (40%), L2 (10%). In our series, Denis classification was used. Most common type was wedge compression fractures (60%) and burst fracture (40%).

Table 2: Comparison between SSIPF and CPSF

	sagittal cobb's angle (°)		
	Open short segment injury level pedicle screw fixation (SSIPSF)	Conventional open short segment pedicle screw fixation (CPSF)	P Value
Pre-op	25.65±4.32	28.02±8.32	>0.05
Post-op	12.38±2.28	16.34±6.04	<0.01
Final follow up	14.46±2.58	22.28±6.24	<0.01
Changes	11.19±1.18	5.77±2.08	<0.01
	Fractured body angle (°) (FBA)		
Pre-op	15.45±4.52	16.40±7.23	0.120
Post-op	25.75±4.06	28.02±5.80	0.110
Final follow up	23.17±4.08	24.82±6.34	0.236
Changes	7.72±0.47	8.42±0.89	0.425
	Anterior vertebral body height (ABH)		
Pre-op	1.66±0.24	1.72±0.34	0.342
Post-op	2.46±0.32	2.56±0.26	0.169
Final follow up	2.26±0.22	2.26±0.28	0.856
Changes	0.60±0.02	0.54±0.06	0.224
	Posterior vertebral body height (PBH)		
Pre-op	2.52±0.24	2.36±0.24	0.22
Post-op	2.84±0.16	2.72±0.14	0.24
Final follow up	2.72±0.18	2.64±0.28	0.16
Changes	0.20±0.06	0.28±0.04	0.25
	Correction rate		
Sagittal cobb's angle	46.52±8.34	26.24±10.10	0.000
FBA	58.32±26.64	46.54±26.44	0.12
ABH	38.72±14.26	34.46±18.32	0.32
PBH	9.01±7.43	12.48±8.40	0.18

In SSIPSF the average pre-op Sagittal cobb's angle was 25.65±4.32°, the immediate post-op 12.38±2.28° & at final follow-up the correction was 11.19±1.18°. In CPSF the average pre-op Sagittal cobb's angle was 28.02±8.32, the immediate post-op 16.34±6.04 & at final follow-up the correction was 14.46±2.58. Fractured vertebral body angle in SSIPSF group the average pre-op fractured vertebral body angle was 15.45±4.52, the immediate post-op 25.75±4.06 & at final follow-up the correction was 23.17±4.08. In CPSF group the average pre-op fractured vertebral body angle was 28.02±8.32, the immediate post-op

28.02±5.80 & at final follow-up the correction was 24.82±6.34. In CPSF group the average pre-op Anterior vertebral body height was 1.66±0.24, the immediate post-op 2.46±0.32 cm & at final follow-up the average correction was 2.26±0.22 cm. Posterior vertebral body height in SSIPSF the average pre-op Posterior vertebral body height was 2.50±0.21 cm, the immediate post-op 2.82±0.14 cm & at final follow-up the average correction was 2.74±0.15 cm. In CPSF group the average pre-op Posterior vertebral body height was 2.36±0.24, the immediate post-op 2.72±0.14 cm & at final follow-up the average correction was 2.64±0.28 cm.

Table 3: Final outcome

Final outcome	SSIPSF	CPSF
Excellent	22	20
Good	24	22
Fair	4	8

It was assessed using Modified Macnab criteria. In SSIPSF group, 22 patients had excellent result 24 had Good result & 4 had fair outcome. In CPSF group, 20 patients had excellent result 22 patients had good result & 8 had fair outcome.

Discussion

It still remains controversial about the optimal management strategy for thoracolumbar/lumbar burst fracture. [13-15] Surgical treatment is generally recommended for patients with neurologic deficits or in those with severe instability. Currently, posterior short segment pedicle screw internal fixation is one of the most common operative approaches to treat unstable thoracolumbar/lumbar burst fracture. Although the clinical results of this surgery are usually satisfactory, progressive kyphosis and a high rate of hardware failure remain a concern. Lack of the anterior column supporting is the main cause of hardware failure. [16,17] Burst fractures of thoracolumbar/lumbar spine can cause neurologic complications and kyphotic deformity, [18-20] which may have a great impact on the patients' life quality. Disputes about the best treatment for spine fracture among doctors as there are, it has come to a consensus among most scholars that operation is needed to treat unstable thoracolumbar/lumbar burst fractures and fractures with existing or potential nerve handicap. Biomechanical and clinical studies have shown that when there is loss of more than 50% of the vertebral body height or more than 25° angulation deformity of the injured segment, acute spinal instability results, and the spinal segment will eventually fail with weight-bearing. [21]

No ideal surgical approach exists at present. By anterior approach we can decompress nerves sufficiently and provide reliable anterior column support. However, this approach requires longer operation duration and the rate of approach related complication and the death rate is significantly higher than posterior approach. Although the combination of anterior and posterior approach can provide the most stable biomechanical repair, the operation time, complication and morbidity rate might be apparently higher than that of the single approach. Traditionally the standalone posterior approach is relatively an easy procedure but can only indirectly reduce a fractured vertebral body, and the means of augmenting the anterior column are limited. [22,23]

In our study group of 100 patients (80 males & 20 females), most common mode of injury was fall from height (70%); RTA (20%); other causes (10%). Most common vertebra involved was L1 (50%), followed by T12 (40%), L2 (10%). In our series, Denis classification was used. Most common type was wedge compression fractures (60%) and burst fracture (40%). In SSIPSF the average pre-op Sagittal Cobb's angle was $25.65 \pm 4.32^\circ$, the immediate post-op $12.38 \pm 2.28^\circ$ & at final follow-up the correction was $11.19 \pm 1.18^\circ$. In CPSF the average pre-op Sagittal Cobb's angle was 28.02 ± 8.32 , the immediate post-op 16.34 ± 6.04 & at final follow-up the correction was 14.46 ± 2.58 . Fractured vertebral body angle in SSIPSF group the average pre-op fractured vertebral body angle was 15.45 ± 4.52 , the immediate post-op 25.75 ± 4.06 & at final follow-up the correction was 23.17 ± 4.08 . Posterior approach instrumentation can be

divided into long-segment fixation (involving more than two upper and lower neighboring levels), short-segment fixation (involving one level above and one below the fractured level) and mono-segment fixation. Nowadays short-segment pedicle screw instrumentation is a well described and popular technique to reduce and stabilize thoracic and lumbar spine fractures. [24] Short-segment fixation offers the advantage of saving motion segments when compared with longer instrumentations. On the contrary, investigators in recent studies have reported earlier implant failure and correction loss as the most important disadvantages of this method. [25,26] Controversy still exists about whether short-segment pedicle screw instrumentation is a suitable method for unstable thoracolumbar/lumbar burst fracture.

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Conclusion

In Open short segment Injury Level pedicle screw fixation (SSIPSF) inclusion of the fracture level into the construct offers a better kyphosis correction, in addition to no instrument failures, without additional complications had better and more rigid construct than conventional open short segment four pedicle screw fixation(CPSF).

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