

Outcome of short segment added injury level pedicle screw fixation and conventional short segment pedicle screw fixation in thoraco-lumbar spine fractures

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Abstract

Background: Conventional open spine surgery has several reported limitations including Hardware failure due vertebral factors, or a combination of both and loss of kyphosis correction. so by adding pedicle screw at injury level vertebrae this limitation was not occurred.

Materials and methods: 50 patients of thoraco-lumbar fractures were selected between Oct 2013 to Oct 2015, with 25 randomly selected cases in each group and were managed by posterior either by conventional pedicle screw fixation (CPSF) or open short segment injury level pedicle screw fixation (SSIPSF).

Results: All the patients were followed up for a period of 6 to 24 months (average was 12.2 months). The kyphotic angle in SSIPSF pre-op was $26.76 \pm 4.33^\circ$, final follow-up was $13.60 \pm 2.63^\circ$ with final correction of $13.16 \pm 3.47^\circ$ compared to kyphotic angle in CPSF pre-op was $29.08 \pm 8.301^\circ$, final follow-up was $21.28 \pm 6.12^\circ$ with final correction of $7.80 \pm 4.60^\circ$. SSIPSF offers better intra-op and post-op advantages over CPSF like Better kyphotic angle correction and better stability with no additional complication and no hardware failure.

Conclusion: SSIPSF is a good procedure for wedge compression & burst fractures of spine in patients. Open 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 CPSF.

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

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Introduction

In CPSF, a four-screw construct connected by rods showed a relatively high rate of instrumentation failure (9-54%) and progressive loss of kyphotic angle with CPSF because on axial loading screws and rods of the CPSF will be exposed to large cantilever bending loads and will be at risk for implant failure. This can be overcome with a technical modifications that adding pedicle screws in the fractured vertebra (intact pedicle).

We evaluated SSIPSF (short-segment injury level fixation) showed that this fixation provides more biomechanical stability than CPSF. The results of both SSIPSF and CPSF in terms of surgical, radiological and clinical outcome after a long-term follow.

Material and Methods

50 patients of thoracolumbar fractures mainly wedge compression & burst fracture without neurological deficits were selected between October 2013 to October 2015 for study. With 25 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

In our study group of 50 patients (38 males & 12 females), Average age group 29.5 years (18-54 years) interval between injury and operation less than 7 days (1-10 days), most common mode of injury was fall from height(68%); RTA (20%); Other causes (12%), 76% injury at the level of thoracolumbar junction T12-L1. Most common vertebra involved was L1 (40%), followed by T12 (36%), L2 (12%).

In our series, Denis classification was used. Most common type was wedge compression fractures(56%)and burst fracture (44%).The wedge compression fracture was 64% in SSIPSF, compared to 48% in CPSF. Burst fractures(36%) in SSIPSF and 52% in CPSF. Out of the 50 patients, 7 patients (14%) were grade D and 43 patients (86%) were grade E according to ASIA score. Of the 7 patients with grade D (3 patients were operated with SSIPSF & 4 were operated with CPSF). The mean duration from operation to last available follow-up films was 12.2 months (range, 8-24months). There were no statistical differences in the age, gender, the interval between the injury and operation, preoperative diagnosis, the injured segments between the two groups.

In SSIPSF the average pre-op Sagittal cobb's angle was $26.36 \pm 4.290^\circ$, the immediate post-op $15.12 \pm 5.380^\circ$ & at final follow-up the correction was $19 \pm 5.408^\circ$. In CPSF the average pre-op Sagittal cobb's angle was

29.08 ± 8.301 , the immediate post-op 15 ± 7.118 & at final follow-up the correction was 19 ± 7.867 . The average correction was 9.96 ± 3.634 .SSIPSF group had better correction than CPSF group.

Fractured vertebral body angle in SSIPSF group the average pre-op fractured vertebral body angle was 15.20 ± 4.628 , the immediate post-op 25.04 ± 4.628 & at final follow-up the correction was 23.36 ± 4.040 . The correction of 8.28 ± 2.052 was achieved. In CPSF group the average pre-op fractured vertebral body angle was 17.40 ± 5.315 , the immediate post-op 26.72 ± 5.496 & at final follow-up the correction was 23.36 ± 4.040 .

Anterior vertebral body height in SSIPSF group the average pre-op anterior vertebral body height was 1.62 ± 0.286 cm, the immediate post-op 2.43 ± 0.318 cm & at final follow-up the average correction was 2.04 ± 0.359 cm. The average correction was 0.41 ± 0.22 cm. In CPSF group the average pre-op Anterior vertebral body height was 1.69 ± 0.31 cm, the immediate post-op 2.57 ± 0.27 cm & at final follow-up the average correction was 2.19 ± 0.37 cm. The average correction was 0.44 ± 0.17 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. The average correction was 0.24 ± 0.12 cm. In CPSF group the average pre-op Posterior vertebral body height was 2.40 ± 0.25 , the immediate post-op 2.80 ± 0.76 cm & at final follow-up the average correction was 2.72 ± 0.91 cm. the average correction was 0.30 ± 0.19 cm.

Clinical results: In CPSF, 21 patients (84%) with grade E pre-op had no change in neurological status. 4 patients with grade D improved to grade E from shows neurological improvement (16%). In SSIPSF, 22 Patients (88%) with grade E had same neurological status even after post-op ASIA grade. 3(12%) patients with grade D had shifted to grade E after post-op period. The surgical results of both SSIPSF and CPSF group are almost similar, although the results of conventional pedicle screw fixation are slightly better.

Final outcome: It was assessed using **Modified Macnab criteria**. In SSIPSF group, 11 patient had excellent result 12 had Good result, & 2 had fair outcome. In CPSF group, 10 patients had excellent result 11 patient had good result & 4 had fair outcome.

Table 1

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	26.76±4.33	29.08±8.30	>0.05
Post-op	11.40±2.41	16.92±6.08	<0.01
Final-follow up	13.60±2.63	21.28±6.12	<0.01
Changes	13.16±3.47	7.80±4.60	<0.01
Fractured body angle(°)(FBA)			
Pre-op	15.32±4.48	17.40±7.12	0.125
Post-op	24.72±4.05	27.04±5.83	0.109
Final-follow up	23.12±4.02	24.88±6.18	0.239
Changes	7.80±1.58	7.48±3.80	0.440
Anterior vertebral body height(ABH)			
Pre-op	1.62±0.28	1.70±0.31	0.350
Post-op	2.45±0.31	2.57±0.27	0.162
Final-follow up	2.24±0.29	2.26±0.28	0.842
Changes	0.62±0.16	0.52±0.23	0.231
Posterior vertebral body height(PBH)			
Pre-op	2.50±0.21	2.35±0.27	0.29
Post-op	2.82±0.14	2.70±0.12	0.26
Final-follow up	2.70±0.14	2.63±0.21	0.15
Changes	0.22±0.16	0.28±0.17	0.23
Correction rate			
Sagittal cobb's angle	48.78±8.26	26.26±10.10	0.0000
FBA	59.31±27.70	47.55±27.47	0.14
ABH	39.90±13.31	34.70±18.37	0.26
PBH	9.08±7.52	12.42±9.40	0.17

Case 1: Patient operated with short segment injury level pedicle screw fixation

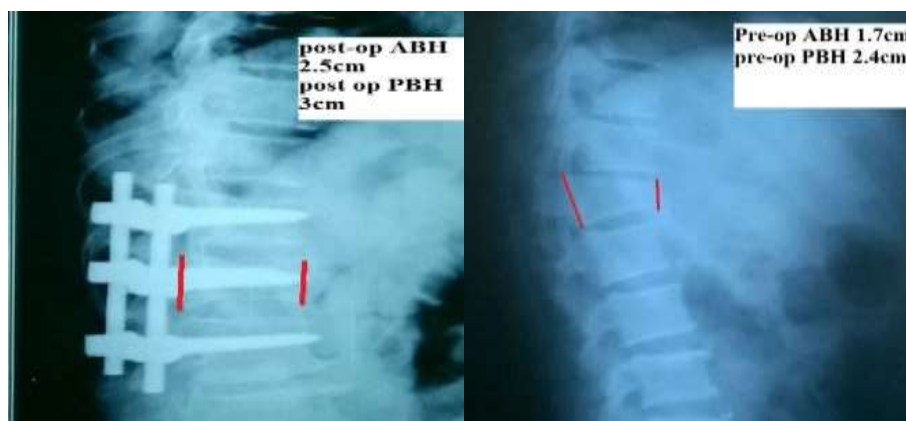


Pre-op

Immediate Post-op

At Final Follow-up

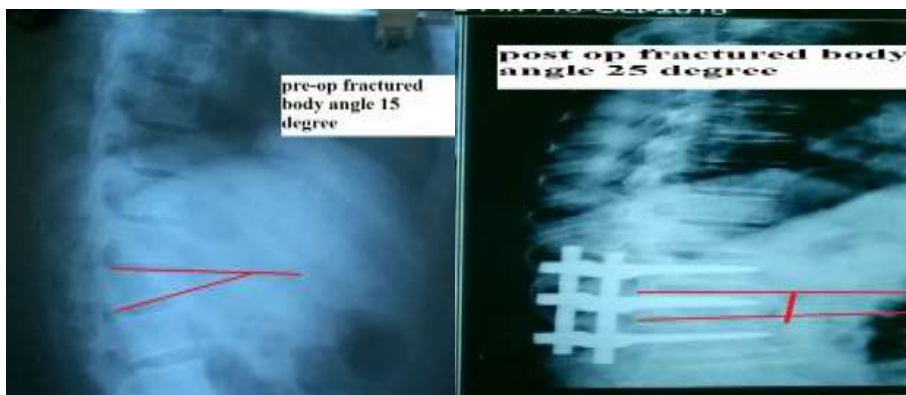
Fig. 1: Patient with wedge compression fracture L-1 vertebrae with No-neurological deficits



Pre-op Post-op
Fig. 2: sagittal cobb's angle



Pre Op Post Op
Fig. 3: Anterior and posterior vertebral height correction



Pre -op post -op
Fig. 4: fractured body angle

Complications

In patients treated with open SSIPSF group, 4 patients had developed superficial infection on post-op day 3, compared 3 patients operated with conventional open short segment pedicle screw fixation on post-op day 3. Patients were treated with higher antibiotics & regular dressing. None of the patients had deep infection.

3 patient had developed hardware failure (implant loosening/rod breakage) after a period of 14 months in CSPF group, No patient had developed hardware failure in open SSIPSF group after a period of 17 months. All patients were treated by implant removal.

3 patient with chest infection in open SSIPSF group and 2 patient in CPSF, 3 patient with worsening of UTI in both pedicle group, one had bed sore in open SSIPSF group & 2 patient had bed sores in CPSF

group. None of the patient had complications of neurological deterioration and DVT.

Discussion

Almost all independent variables showed great similarity between the two groups, hence the aim of having two relatively homogenous groups was achieved. Inclusion of the fracture level in the construct did not lengthen the operation or hospitalization, nor did it increase the amount of blood loss or post-operative infections. Majority of the patients in our study were male, 38 patients compared to 12 female patients, injuries are more common between 20-30 years of age, most common type was wedge compression fracture (56%), Most common vertebra involved was L1 (40%), Fall from height was the most common mode of injury (68%) of the cases.

In open SSIPSF the average pre-op Sagittal Cobb's angle was $26.76 \pm 4.33^\circ$, the immediate post-op $11.40 \pm 2.41^\circ$ & at final follow-up the correction was $13.60 \pm 2.63^\circ$ and correction rate is 48.77% and in CPSF group the average pre-op Sagittal Cobb's angle was 29.08 ± 8.30 , the immediate post-op 16.92 ± 6.08 & at final follow-up the correction was 21.28 ± 6.12 . The average correction was 7.80 ± 4.60 and correction rate is 29.26%. P value of both group preoperatively is insignificant (>0.05) and at final follow up it is significant (<0.001) and correction is significant (<0.001).

Farrokhi et al study (2010) conventional open short segment pedicle screw fixation group mean sagittal Cobb's angle pre operatively was 20 ± 13 and at final follow up it is 19 ± 10 average correction was – (minus) 29%. In open short same segment six pedicle screw fixation group mean preoperative sagittal Cobb's angle was 19 ± 13 . At final follow up it was 14 ± 8 with correction was 6%. P value of both group preoperatively was insignificant (0.613) and at final follow up it was significant (0.008) and correction was significant (0.040). Open SSIPSF had better correction of sagittal Cobb's angle than CPSF group

Fractured vertebral body (°) angle: In open SSIPSF group the average pre-op Fractured vertebral body angle was 15.32 ± 4.48 the, immediate post-op 24.72 ± 4.05 & at final follow-up the correction was 23.12 ± 4.02 . The correction of 7.80 ± 1.58 was achieved. In CPSF group the average pre-op fractured vertebral body angle was 17.40 ± 7.11 , the immediate post-op 27.04 ± 5.83 & at final follow-up the correction was 27.04 ± 5.83 . The correction of 7.48 ± 3.80 was achieved. Open SSIPSF group had slightly better correction than CPSF group.

Anterior vertebral body height: In open SSIPSF group the average pre-op Anterior vertebral body height was 1.62 ± 0.28 cm, the immediate post-op 2.45 ± 0.31 cm & at final follow-up the average correction was 2.24 ± 0.29 cm. The average correction was 0.62 ± 0.16

cm and correction rate was 39.9%. In CPSF group the average pre-op Anterior vertebral body height was 1.70 ± 0.31 cm, the immediate post-op 2.57 ± 0.27 cm & at final follow-up the average correction was 2.26 ± 0.28 cm. The average correction was 0.52 ± 0.23 cm. correction rate was 34.7%.

Mahar et al. (2007) study shows mean anterior vertebral body height was 58% of normal before surgery. After surgery height was 89% of normal and at final follow-up, 78%.

Posterior vertebral body height: In open SSIPSF group 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 2.70 ± 0.14 cm. The average correction was 0.22 ± 0.16 cm. In CPSF group the average pre-op posterior vertebral body height was 2.35 ± 0.27 , the immediate post-op 2.70 ± 0.12 cm & at final follow-up the average correction was 2.63 ± 0.21 cm. The average correction was 0.28 ± 0.17 cm.

Limitation of motion: In open SSIPSF group average limitation of motion is 19.44 ± 5.37 degree while in CPSF group it is 17.76 ± 5.32 degree. With P value is 0.272 which is insignificant.

Farrokhi et al study (2010) in convention group it was 19 ± 14 degree and in inclusion group it was 14 ± 14 degree with p value was 0.141 (<0.05) insignificant.

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).

Bibliography

1. McLain FR, Sparling E, Benson RD. Early failure of short-segment pedicle instrumentation for thoracolumbar burst fractures: a preliminary report. *J Bone Joint Surg Am.*
2. Majid-Reza Farrokhi, Ali Razmkon, Zohreh Maghami, Zahra Nikoo (2010) Inclusion of the fracture level in short segment fixation of thoracolumbar fractures *Eur Spine J* (2010).
3. Guven O, Kocaoglu B, Bezer M, Aydin N, Nalbantoglu U. The use of screw at the fracture level in the treatment of thoracolumbar burst fractures. *J Spinal Disord.*
4. Mahar A, Kim C, Wedemeyer M, Mitsunaga L, Odell T, Johnson B, Garfi n S. Short-segment fixation of lumbar burst fractures using pedicle fixation at the level of the fracture. *Spine.*
5. Gurwitz GS, Dawson J, McNamara MJ, Federspiel CS, Spengler DM. Biomechanical analysis of three surgical approaches for lumbar burst fractures using short segment instrumentation. *Spine.*

6. Magerl F, Aebi M, Gertzbein SD, Harms J, Nazarian S (1994) A comprehensive classification of thoracic and lumbar injuries. *Eur Spine J*.
7. Jonathan-James T. Eno BSc; James L. Chen MD; and Morris M. Mitsunaga MD (2012) Short Same-Segment Fixation of Thoracolumbar Burst Fractures *Hawaii J Med Public Health*. 2012 Jan;71(1):19–22.