

Comparison of Posterior Short-segment Pedicle Screw Fixation with or without Fusion in Thoracolumbar Burst Fractures

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ABSTRACT

Introduction: Treatment of unstable Thoracolumbar vertebra burst fractures has seen a paradigm shift from conservative to surgical modalities with either a short or long-segment posterior fixation with or without fusion.

Aim: To assess the functional and radiological outcome in burst fractures of thoracolumbar vertebrae treated with short-segment posterior instrumentation with and without fusion.

Materials and Methods: The study was conducted on 31 patients, divided into two groups, with thoracolumbar burst fractures. Patients above 18 years of age, with or without neurological deficit, Kyphosis >30°, anterior vertebral height loss >50%, spinal canal narrowing >40% were included in the study. Group A (n=15) had patients in which posterior short-segment pedicle screw fixation was done while patients with pedicle screw fixation combined with posterolateral fusion were in Group B (n=16). The final outcome was measured using the Modified Mcnab's questionnaire, low back outcome scale of Greenough and Fraser and Frankel scoring system at an interval of 3, 6 and 12 months were calculated using the Mann-Whitney's U-test which was not statistically significant (p=0.770).

Results: The most common mode of injury was road traffic accident affecting 23 (74.2%) cases. L1, L2 and T12 were the most commonly involved vertebrae. The time duration between the injury and surgery was 12.44±9.6 days in Group A and 8.6±2.7 days in Group B (p=0.1273). Intraoperative blood loss was 468±94.6 mL in Group A and 693±88.3 mL in Group B (p<0.001). The mean surgical time in Group B cases (149.33±4.72 minutes) was more than those in Group A (110.8±4.65 minutes) (p<0.001). The average duration of hospital stay was 27.8±7.33 days in Group A and 24.3±8 days in Group B (p=0.3056). There was a gradual improvement in Frankel scoring, anterior vertebral height and kyphotic angle at last follow-up. The Greenough low back outcome score was 45.25 in Group A and 46.10 in Group B cases which were not significant. As per the modified Mcnab's questionnaire, 17 (54.83%) had excellent, 10 (32.2%) had good and 4 (12.9%) had the poor functional outcome. Superficial infection and screw loosening were apparent in 3 (9.6%) cases.

Conclusion: Posterolateral fusion combined with fixation is not superior to fixation alone in burst thoracolumbar fractures.

Keywords: Kyphosis, Unstable fractures, Vertebra

INTRODUCTION

Vertebral column fractures are reported to occur in about 6% of trauma patients, with half of them involving the spinal cord or the nerve root [1]. About half of the burst fractures involve thoracolumbar region owing to the presence of biomechanically weak junction especially between T11 and L2 vertebra [2]. As per Denis, burst fractures involve the failure of at least the anterior and middle columns of the spine [3]. These fractures can occur as a result of high-velocity trauma in young adults while a trivial fall from standing position can lead to such fractures in geriatric age group due to the osteoporosis [3]. It is estimated that around 20%-40% of these injuries are associated with neurological deficit which can be associated with kyphotic deformity [2].

The ideal treatment modality to be used in burst fractures of thoracolumbar region still remains controversial with no established consensus for the same [4-6]. Non-operative options include rest, use of brace, moulded orthosis or hyperextension cast with early mobilisation. Rotorest bed has proved to be effective even in severe fractures [4,7]. Conservative methods can sometimes lead to worsening of spinal stenosis, increasing the pressure on vertebral body or worsening of neurological symptoms. Indications for surgery include progressive neurological deterioration or an incomplete neuro deficit, kyphotic deformity >30°, >50% loss of vertebral body height, canal narrowing of >40%-50% [8,9].

Surgical options can comprise of either an anterior or posterior approach. Anterior corpectomy and fixation have shown good results, however, increased morbidity and steep learning curve are the main constraints for its routine use [10]. Posterior approach, on the other hand, is technically easy to perform and is less extensive. Various modifications have been made in terms of instrumentation and technique. Pedicle screws can minimise the range of movements at spinal segments which can further reduce the damage to soft tissues and increase the rate of synostosis giving a three column fixation [11]. The fixation can either be short or a long-segment. Short-Segment instrumentation involves one level cephalad and one level caudal pedicle screw fixation whereas the long-segmental instrumentation involves more than three levels. Literature has shown variable results with the use of short-segment fusion with some studies favouring it [10,12], while others have shown high failure rate [13]. Long-segment instrumentation has shown to have a good clinical and functional outcome in few studies [12,13]. While several studies recommend posterior fixation augmented with fusion [14-16], there are few studies which suggest that fusion offers no added advantage [2,17-20].

The aim of the present study was to compare the functional and radiological outcome in patients with thoracolumbar burst fractures treated by short-segment pedicle screw fixation with or without posterolateral fusion. Authors hypothesis was that there was no difference between both the techniques and that the posterolateral fusion offers no added advantage when combined with fixation.

MATERIALS AND METHODS

The present study was conducted at a Tertiary Care Centre in New Delhi, India, between April 2012 and April 2014 on 31 patients with burst type of thoracolumbar fractures. Patients above the age of 18 years with or without neurological deficit, Kyphosis >30°, anterior vertebral height loss >50%, spinal canal narrowing >40%-50%, involvement of two or more columns were included in the study. Pathological fractures and undisplaced fractures requiring conservative management were excluded from the study.

All the patients were randomly selected using the closed envelope technique. The patients were asked to open the closed opaque envelope just prior to the surgery. A thorough clinical examination was done for all the patients as per the American Spinal Injury Association (ASIA) scale [19] and Frankel grading was done to assess the severity of spinal injury. Preoperative haematological and radiological workup was done for all the patients enrolled in the study. The patients were divided into two groups. Group A (n=15) had patients in which posterior short-segment pedicle screw fixation was done while patients with pedicle screw fixation combined with posterolateral fusion were included in Group B (n=16). Well written informed consent was obtained from all the patients enrolled in the study. Ethical Committee Approval was obtained prior to the commencement of the study (DDU/00002657/2012/04). The final outcome was measured using the Modified Mcnab's questionnaire [20], low back outcome scale of Greenough and Fraser [21] and Frankel scoring system at a regular interval of 3, 6 and 12 months postoperatively. The modified Mcnab's questionnaire is subjective which is reported between excellent and poor depending upon the severity of the pain and the ability to do activities of daily living. The low back score of Greenough has 13 parameters which assess patient in terms of pain, activities of daily living like sleeping, walking, sitting, travelling and dressing. Out of the total scores of 75 points, score >65 is excellent while <29 is said to be poor. The Frankel grading is classified from A to E depending upon the sensory and motor function with E as normal sensory and motor function and grade A as complete loss of sensory and motor function.

STATISTICAL ANALYSIS

Statistical analysis was conducted with the statistical package for the social science system version SPSS 22.0. Continuous variables were presented as mean±Standard Deviation (SD) and categorical variables were presented as absolute numbers and percentage. Ordinal non-parametric data (Functional outcome) between the groups were compared using Mann-Whitney's U-test. The pre and postoperative values of the scoring system were calculated using the unpaired t-test. The p-value of <0.05 was taken as statistically significant.

Surgical Technique

General anaesthesia and prone position were used in all the patients. All the surgeries were performed by single surgeon AB. Three doses of second generation cephalosporins (Inj Cefuroxime 1.5 g) were injected 30 minutes prior to the incision followed by two doses at 12 hourly intervals. A level proximal and distal to the fractured vertebrae was marked preoperatively with the help of C arm image intensifier in both the orthogonal views. After subcutaneous dissection, the transverse process and pedicles were cleared off the attachments. The entry at the pedicles was marked and four screws were inserted (two proximal and two distal to the fracture site). The decision regarding the need

for decompression was made depending on the neurological status. Posterolateral fusion was done at this stage in Group B patients after harvesting the graft from the posterior iliac crest. The final reduction was done using the distractive forces at the longitudinal rods which were connected to the pedicle screws and the reduction was checked in C arm intraoperatively. Similar pain control management protocols were followed for all the patients. The patients were mobilised with the help of brace from postoperative day one. Neurological status along with radiological examination was done of all the patients at 3, 6 and 12 months respectively.

RESULTS

The mean age of patients in Group A was 36.81±4.21 years and 31.87±3.06 years in Group B. There were 17 (54.8%) males and 14 (45.2%) females in the present study. The most common mode of injury was RTA and L1/L2 vertebra was the most common vertebra to get fractured [Table/Fig-1].

Variables	Group A (n=15) (%)	Group B (n=16) (%)
Mode of injury		
Road Traffic accident	11 (73.4)	12 (75)
Fall from height	4 (26.4)	4 (25)
Vertebra involved		
T11	1 (6.6)	1 (6.25)
T12	2 (13.4)	3 (18.75)
L1	5 (33.4)	4 (25)
L2	6 (40)	5 (31.25)
L3	1 (6.6)	3 (18.75)

[Table/Fig-1]: Mode of injury and Level involved.

There was a gradual improvement in Frankel scoring, reduction of the anterior vertebral height and kyphotic angle from preoperative status to subsequent follow-ups at one year [Table/Fig-2-4]. The Greenough low back outcome score was 45.25 in Group A and 46.10 in Group B cases which were not statistically significant (p=0.07). As per the modified Mcnab's questionnaire 8 (50%) cases had excellent, 6 (37.5%) had good and 2 (12.55%) cases had poor functional outcome in Group A, while 9 (60%) cases had excellent, 4 (26.7%) had good and 2 (13.33%) cases had poor functional outcome in Group B postoperatively. One (6.25%) in Group A and 2 (13.33%) cases in Group B had superficial infection. All the three patients were treated with oral antibiotics. Screw loosening was apparent in 2 (12.5%) cases in Group A and 1 (6.66%) case in Group B respectively.

Group (According to Frankel scoring)	Group A (n=15)			Group B (n=16)		
	Pre-op	Post-op	At 1 year	Pre-op	Post-op	At 1 year
A	3	2	2	2	2	2
B	0	0	0	0	0	0
C	5	1	0	1	1	0
D	2	5	0	9	5	0
E	6	8	14	3	7	13

[Table/Fig-2]: Frankel scoring for neurological status.

Anterior vertebral height	Groups	Mean	Std. Deviation	n	Test of significance	p-value
Pre-op	A	56.06	7.853	16	Unpaired t-test	0.0506
	B	62.07	8.556	15		
Immediate post-op	A	25.69	6.194	16	Unpaired t-test	0.2345
	B	28.47	6.556	15		
After 1 year	A	25.75	4.612	16	Unpaired t-test	0.0101
	B	30.47	4.941	15		

[Table/Fig-3]: Anterior vertebral height comparison.

Variables	Group	Mean	Std. Deviation	n	Test of significance used	p-value
Kyphotic angle Preoperative	A	27.69	6.72	16	Unpaired t-test	0.6598
	B	28.67	5.43	15		
Kyphotic angle at three months follow-up	A	7.38	2.705	16	Unpaired t-test	0.0989
	B	8.87	2.100	15		
Kyphotic angle at six months follow-up	A	8.12	2.335	16	Unpaired t-test	0.0363
	B	9.73	1.668	15		
Kyphotic angle at one year follow-up	A	9.13	2.895	16	Unpaired t-test	0.1594
	B	10.40	1.844	15		

[Table/Fig-4]: Kyphotic angle calculation.

DISCUSSION

The thoracolumbar junction being the transition zone is more prone to injuries which can lead to deformity and even neurological deficits. The most commonly involved vertebra in Group A were L1 and L2 while T12 and L1 vertebrae were seen more frequently in patients of Group B. The findings of the present study were similar to others in literature [10,12,22]. There was a male predominance seen in the present study affecting 54.8% cases which were consistent with other studies [23,24]. Tezeren G et al., in their study of 42 patients compared the functional and radiological outcome between long-segment instrumentation with and without fusion, and found no significant difference [10]. We had no experience with long term segmental instrumentation in the present study. In a retrospective analysis by Hwang JU et al., comparing the results of short-segment fixation and fusion versus only fusion [12]. They concluded that fusion has better outcome in terms of kyphosis, pain and implant-related complications. Similarly, the rate of screw loosening was 12.5% in fixation group (12.5%) was more than the fixation and fusion group (6.66%) in the present study. In contrast, the other parameters like change in kyphosis angle and vertebral height had no significant difference.

Frankel scoring system helps to assess the severity of spinal injury with respect to the sensory and motor involvement. At the final follow-up, 87.5% cases in Group A and 86.6% cases in Group B had grade E Frankel's grading. Thus, there was a gradual improvement in the sensory as well as motor status of the patients. The role of fusion has been controversial. Proponents of the non-fusion believe that it avoids the donor site morbidity, reduces the intraoperative surgical duration and blood loss while preserving the mobility of the adjacent segments [2]. These observations have been confirmed by Quian BP et al., Hwang JU et al., Yang X [7,12,23]. In the present study, the average surgical duration and intraoperative blood loss among Group A and Group B were statistically significant. The opponents, on the other hand, are of the view that the non-fused segments may alter the biomechanics caudal and cephalad to the fixed vertebra, it eliminates the low back pain symptoms and helps in achieving a better deformity correction [10,22,23].

The preoperative kyphotic angle in Group A was 27.69±6.720 which improved to 9.13±2.890 at the 12 month follow-up. Similarly, the preoperative kyphotic angle in Group B was 28.67±5.430 which reduced to 10.40±1.840 at the final follow-up. The change in the kyphotic angle was not found to be statistically significant (p=0.082). The low back outcome scale of Greenough and Fraser showed no difference between both the groups (p=0.07). In the present study, as per the modified McNab's questionnaire, 87.09% of the cases had excellent to good results at the final follow-up. The posterolateral fusion group patients had no better outcome than the non-fusion group. A recent meta-analysis by Tian NF et al., showed no upper hand of fusion with fixation over fixation alone

in unstable thoracolumbar burst fracture fixations. Similar findings were observed in the present study [25].

LIMITATION

The present study has some limitations. Sample size determination was not done which remains the drawback of the present study. Also, the follow-up of the patients is short-term (one year) when the failures are not that prominent. The difference between the Greenough and Fraser score was not statistically significant which might be due to the low sample size which is a limitation of the present study.

CONCLUSION

The dilemma in treating the burst fractures of thoracolumbar spine still exists in terms of fusion versus non-fusion. The findings of the present study affirm that fusion is not superior to fixation for the thoracolumbar burst fractures. However, further meta-analysis and large randomised control trials are required for defining a treatment protocol.

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