

Inclusion of fracture vertebra pedicle in the short segment fixation of thoracolumbar burst fractures: A pilot study

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Abstract

Background: The short segment fixation pedicle screw fixation of thoracolumbar burst fractures has advantage of fixing less number of motion segments but failure of short segment fixation and that it is not suitable for all types of burst fracture were reported. Concept of including the fracture vertebra into the short segment fixation to increase the construct stiffness has been proposed. **Material and Methods:** Prospectively 20 patients of thoracolumbar burst fracture were operated at Department of Orthopaedics, Government Medical College and Hospital, Nagpur. Both or one pedicle of the fractured vertebra was included into the short segment fixation. Patients were followed up at 1 month interval till six months and then at six monthly intervals. Segmental kyphotic angle was evaluated preoperatively, postoperatively and at each follow up. Frenkel grading was also evaluated. **Results:** We report a mean follow up of six months. The average preoperative kyphotic angle was 18+/-5 deg and the average post operative angle was +4+/-6 deg. The average loss of correction was 2 deg till last follow up. No instance of failure of implant noted. **Conclusion:** We found that adding pedicle screw at the fracture level does help in achieving good correction of deformity intra operatively and that it does help in maintain that correction as indicated by our average 6 months follow up.

Keywords: thoracolumbar.

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INTRODUCTION

Acute fracture of the thoracolumbar spine is a major cause of disability in adult population. In India approximately 20000 new cases of spinal cord injury are added annually. Dorsolumbar injury being the commonest¹. In spite of our evolving understanding of biomechanics of spinal injury, evidence-based guidelines for the treatment of traumatic fractures of the thoracic and lumbar spine are lacking². Even basic questions, whether to treat acute vertebral fractures surgically at all, have not

yet been answered for the total spectrum of traumatic lesions². Surgery has certain definite advantages (period of inability to work and radiological correction) over conservative management and is recommended in patients with clinco-radiological evidence of spinal instability and neurological deficit^{3,4}. Vaccaro 2005 proposed the Thoracolumbar Injury Severity Score to determine which people may benefit from operative intervention based on the mechanism of injury, the neurological status of the patient, and the integrity of the posterior ligamentous complex⁵. Posterior transpedicular fixation has been the preferred method for stabilizing acute unstable thoracolumbar fractures as it provides three column fixation which is biomechanically desirable⁶. Pedicle screw fixation can be divided into several categories based on the lengths of the fixed segments and of pedicle screws in the injured vertebra, as well as on transpedicular grafting and postero-lateral fusion. Short segment fixation that is pedicle screws inserted bilaterally into two vertebrae, one above and one below the fractured vertebra became popular as it

decreased the number of motion segments sacrificed. However several groups have reported an unacceptably high failure rate using this technique⁷⁻¹⁰. Evidence from biomechanical and clinical studies is accumulating regarding the beneficial effect of adding pedicle screws at the fracture level in the short segment construct¹¹⁻¹⁷. We conducted a pilot study at Government Medical College and Hospital, Nagpur evaluating the short term results of inclusion fracture level in the short segment fixation of thoracolumbar burst fractures.

MATERIAL AND METHODS

Prospectively 20 patients with thoracolumbar burst fracture admitted to Orthopaedics department of Government Medical and Hospital were included in this study. Those patients with age above 60 yrs and with pathological lesion (infection/tumor) were excluded. All patients were evaluated with X ray, Computed tomography scan and Magnetic resonance imaging. Indications for surgery were neurological deficit, unstable fracture pattern and posterior ligamentous injury. After obtaining informed consent from the patient, they all were operated using a similar technique. Under general anaesthesia patient was placed in prone position over spine frame which put a lordotic force on thoracolumbar spine due to gravity and assisted in correction of deformity. Pedicle screws were inserted using free hand technique into both pedicles of vertebra one level above and one level below the fracture vertebra. Also pedicle screws were inserted into one or both pedicles of the fractured vertebra. Pre contoured rods (in lordosis) were then tightened over the screws. Reduction was confirmed with image intensifier. Laminotomy was performed to check the adequacy of indirect decompression and if required laminectomy and postero-lateral decompression was done. Post operatively patients were mobilized immediately with a custom made Taylor’s brace. Patients were advised to wear brace for at least 6 weeks. Patients

were followed up every 6weeks till 6 months and then every 6 months. Neurological status of the patients was noted at admission, at discharge and then at follow ups. Segmental kyphotic angle (angle between the line along the superior endplate of the vertebra above the fracture level and line along the inferior endplate of the vertebra below the fracture level) was documented in the preoperative and post operative x rays and in x rays done at follow up.

OBSERVATION AND RESULTS

Out of 20 patients operated 14 were male. The commonest level injured was 12th thoracic vertebra (Table 1). The average operating time was 90 minutes. The average blood loss was 150 ml. None of the patients had any neurological complication. There was no incidence of misplaced pedicle screw. No case of post operative infection was noted. The average preoperative segmental kyphotic angle was 18+/-5 and the average post operative angle was -4+/-6. We have a mean follow up of 6 months. The average loss of correction of kyphosis was 2 degrees till last follow up. The neurological status of the patients on admission and at last follow up is given in table 2. All patients had improvement of at least one Frenkel grade till the last follow up.

Table 1

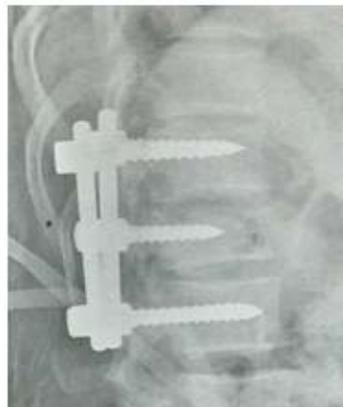
Level of injury	D8	D11	D12	L1	L2	L3	L4
No. of patients	1	2	7	5	2	2	1

Table 2

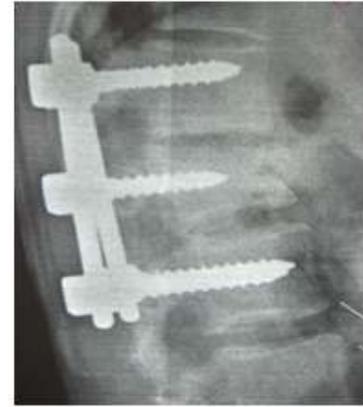
Frenkel Grade	Pre operative	At final follow up
A	7	0
B	3	2
C	5	6
D	2	7
E	3	5



Figure 1: a) L1 fracture



b) Immediate post operative correction



c) 12 months follow up of same patient

DISCUSSION

The treatment of thoracolumbar burst fractures is controversial. Pedicle screw fixation has become a preferred option for treatment as it provides three column fixation, no need for posterior column to be intact and because of strong bone –screw interface permits shorter constructs which lessens the number of motion segments sacrificed¹⁸. As noted earlier⁷⁻¹⁰ several studies reported failure of the short segment fixation in the treatment of thoracolumbar burst fractures. In order to retain the advantages of the short segment fixation and still avoid failures use pedicle screw in the fractured vertebra came into being. In 2007 Mahar *et al* reported their review of 12 patients and biomechanical testing of cadaveric spine. They concluded that segmental fixation of burst fractures with screws at the level of fracture improved the biomechanical stability¹¹. Guven *et al* reported a randomized study involving seventy two patients. They found that fracture level screw combination provided better intra operative correction and maintenance in the treatment of unstable thoracolumbar burst fractures¹². Farrokhi *et al* (2010) reported randomized trial involving 80 patients. They also concluded Inclusion of the fracture level into the short segment construct has offered a better kyphosis correction, in addition to fewer instrument failures, without additional complications¹⁴. Baaj *et al* reported cadaveric study in which 4 types of pedicle screw construct were compared in a simulated L1 fracture. They found that adding index-level pedicle screws to short-segment constructs improves stability, although stability remains less than that provided by long-segment constructs¹⁵. Wang *et al* reported a cadaveric study done on fresh frozen calf spines. They reported that addition of intermediate screws at the level of a burst fracture significantly increased the stability of short segment pedicle screw fixation¹⁶. Kose *et al* reported results of hyperlordotic short segment fixation with index screw in 39 patients. They reported that this technique yields excellent radiological results with a very low rate of failure regardless of whether the fractures score high or low according to Load sharing classification¹³. Our pilot study of 20 patients with average follow up of 6 months has shown good results with regards to correction and maintenance of deformity and no failure of fixation. It has been reported that most of the loss of correction occurs in the first 6 months¹³. With this fact our study assumes more importance as even after achieving a significant correction of deformity there was only 2deg of average loss of correction of deformity at the end of average follow up of 6 months and no instance of implant failure. Few more clinical studies (Meelab P 2012, Tian JW *et al* 2011, Ming Yang *et al* 2013, Jonathan JT *et al* 2012)¹⁹⁻²² have proposed that inclusion of fracture vertebra in short

segment fixation helps achieving better intra operative reduction of deformity, does not interfere with fracture healing, maintains the reduction and is associated with fewer failure rates as compared to simple short segment fixation. Approximately 60% of the fixation strength of the thoracic and lumbar pedicles is in the pedicle itself²³. And almost always the pedicle of the fractured vertebra is intact, hence it can effectively as an additional point of fixation. It has been proposed that index-level screw increased the longitudinal points of fixation from 4 to 5 points, and the newly added middle fixation point may have acted as a pivot point about which the middle motion segments were forced to bend¹⁵. Furthermore, this additional point of fixation allows for a 3-point reduction maneuver, analogous to that used for reduction of long bone fractures and increased construct stiffness shields the fractured vertebral body from anterior loads¹⁶. We conclude that there is enough evidence accumulating, including our study that using the fracture level pedicle screw in short segment fixation of thoracolumbar burst fractures helps achieving good correction of deformity and also its maintenance at least in short term. We intend to include more patients and follow them up to evaluate long term results.

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