Long Segment Transpedicular Screw Fixation With Decompression in Incomplete Thoracolumbar Spine Injury

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Abstract

Background: Traumatic fracture of the thoracolumbar spine is one of the major causes of disability in adult population of Bangladesh. Long segment transpedicular (LST) screw fixation has gained popularity in the last decade as a effective surgical treatment. **Objective:** To evaluate LST screw fixation in incomplete thoracolumbar spine injury among the patients attending at National Institute of Traumatology and Orthopaedic Rehabilitation NITOR, Dhaka. **Methods:** This prospective follow up study was conducted in the Department of Orthopedics, NITOR, Dhaka, over a period of 2 years from January 2014 to December 2015. Incomplete thoracolumbar spinal injury patients attending at the hospital were the study population. A total of 20 patients aged 18-60 years irrespective of sex were included in the study. The patients were treated by Long segment (LS) posterior instrumentation and followed periodically up to 6 months with a structured data collection sheet developed to record detail history, physical examination, investigations, operative procedure and follow-up findings of the patients. Pre and post operative patient status were measured by ASIA grading of spinal cord injury. At the end of 6 months patient's satisfaction was assessed by modified Macnab criteria. **Results:** A total of 20 patients, male female ratio and mean age were 5.67:1 and 33.2±11.8 years. Fifty percent cases were due to road traffic accident and the rest 50.0% were due to high energy falls. The pre-operative ASIA grade status of the patient's SCIs was B in 9 (45.0%), C in 10 (50.0%) and D in 1 (5.0%) patients. At the end of 6 month after operation, all the patients had improvement in neurological function: ASIA grade C was in 3 (15%), D was in 8 (40%) and E was in 9 (45%) of study patients. All the patients but one were satisfied about the outcomes of the (LS) posterior instrumentation. **Conclusion:** Long segment transpedicular screw fixation with decompression by laminectomy is an effective method of treatment of thoracolumbar spine Iinjuries. This method enhances anatomical, clinical and functional recovery, reduce pain and improve working status with early rehabilitation.

Key Words: thoracolumbar spine injury, long segment transpedicular screw fixation, ASIA grade, modified Macnab criteria

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Cite this as: BMCJ 2019; 5(2): 21-28

Received : 11 January 2019
Accepted : 15 February 2019

Introduction

Thoracolumbar junction is the mechanical transition zone between rigid thoracic and more mobile lumbar spine. Vertebral fracture in this area are usually extremely unstable with marked kyphotic deformity. At this level spine injury associated with damage to cord or caudaequina 14-38%.[1] Inserting the screw only one level above and below the fractured segment might not have provided adequate stability.[1,2] Traumatic fracture of the thoracolumbar

spine is a major cause of disability in adult population. It can be treated conservatively but the surgical treatment is the modern way of treatment. Among the surgery posterior transpedicular fixation has been the preferred method for stabilizing acute unstable thoracolumbar fractures.[3]

Fractures at the thoracolumbar junction T11—L2 are most problematic, since the injured segments are junction between the rigid thoracic spine and the lumbosacral vertebrae. The type of instrumentation used depends on the injured level, the fractured pattern, the need for stabilization or decompression and the surgeon's level of experience and training. Long segment transpedicular screw fixation in unstable thoracolumbar spine has gained popularity in the last decade as it reduce the kyphosis, decreased instrument failure and sagittal collapse as well as relieve of pain. Residual deformity at this level is poorly tolerated and mechanical imbalance predisposes to pain and construct failure.[4]

Short-segment pedicle screw construct is the method of choice for reduction and stabilization of unstable thoracolumbar spinal injuries. Many investigators have recently reported a high rate of instrument failure. The use of segmental transpedicular fixation two levels above and two level below the fractured vertebra reduce the kyphosis, decreased instrumental failure and sagittal collapse.[5] It has been demonstrated that short-segment (SS) instrumentation is associated with an unacceptable rate of failure. The highest rate of the instrumentation failure resulting in re-kyphosis of the entire segment is associated with SS posterior reduction and stabilization of burst fractures showing the inadequacy of the SS transpedicular instrumentation used for the treatment of thoracolumbar and lumbar fractures.[6] Burst fractures are common thoracolumbar junction injuries. Dorsal fixation of the thoracolumbar burst fractures is widely accepted as a treatment option, especially in unstable burst fractures.[7]

Burst fractures most frequently affect the thoracolumbar region due to the fulcrum of increased motion at the T12–L1 junction. Approximately 90% of spinal fractures are found in the thoracolumbar segment. They often lead to collapse of the vertebral body and an associated kyphotic deformity. This vertebral collapse is usually accompanied by varying degrees of spinal canal invasion which may or may not result in neurological compromise. Clinical results depends on reduction with transpedicular screw fixation and lateral fusion.[8] Inspite of progress in imaging, understanding of spinal stability and modern classification systems, there is no generally accepted consensus regarding the type of the surgical approach in the treatment of thoracolumbar fractures. But several authors showed that a long posterior stabilization is the most frequently used treatment modality.[9] Fractures involving the anterior and middle columns of the vertebrae and the canal were mildly compressed by the retropulsed bone fragment. However, there was no obvious neurologic deficit in these patients. They initially underwent conservative treatment and thoracolumbar spinal orthosis (TLSO) brace for at least 3 months but the intractable pain caused patients to be bedridden for prolonged periods of time and

limited daily activity. Surgical intervention is often necessary for the patients with unstable thoracolumbar fractures or those with neurologic deficits related to compression of the neural structures by bony elements or hematomas leading to partial cord injuries or caudaequina injuries. In patients with fractures and associated spinal cord injury, the efficacy of decompressive surgery varies depending on the level and degree of injury. [10]

The recommended method for examining neurological function is the American Spinal Injury Association (ASIA) method and neurological function impairment should be graded according to the ASIA Impairment Scale. Examination of anal sensation and sphincter autonomic contraction should be performed to identify complete or incomplete spinal cord injury as a standard protocol.[11] The goal of treatment in thoracolumbar fractures are to restore vertebral column stability and obtain spinal canal decompression. After Holds worth described vertebral burst fractures in 1983, numerous articles and treatment methods, were developed, including posterior fixation with pedicular screws and rods, fusion or both.[12] However the present study was conducted to evaluate Long Segment Transpedicular Screw Fixation in Incomplete Thoracolumbar Spine Injury among the patients attending at NITOR, Dhaka.

Materials & methods

This was a prospective follow up study. The study was conducted in the Department of Orthopedics, NITOR, Dhaka, over a period of 2 years from January 2014 to December 2015. Patients having unstable thoracolumbar spine injury with incomplete neurological deficit of single vertebra envelopment attending at NITOR were the study population. A total of 20 patients, 18 to 60 years of age with incomplete neurological deficit of single vertebra envelopment were included in this study by purposive sampling. Patients having a history of spinal surgery, infective disease of spine (TB spine), bone tumour of spine, complete cord lesion and associated cervical spine, head injury and chest injury were excluded from the study. Prior permission was taken from Ethical Review Committee, NITOR, Dhaka, Bangladesh to conduct this study. The patients were treated by long-segment (LS) posterior instrumentation and followed periodically up to 6 months after operation . All the selected patients were operated within 21 days of admission.

A structured data collection sheet was developed to record detail history, physical examination, investigations, operative procedure and follow-up findings of the patient and finalized after pretesting. Data were collected by interview and physical examination of the patients, from treatment records and interview of the concerned attending doctors during pre and post operative period periodically up to 6 months. Plain x-ray both anterior posterior & lateral view and MRI of thoracolumbar region for all cases were done. 3D CT scan was done, if necessary. Pre and post operative patient status were measured by

ASIA grading of spinal cord injury.[13] At the end of 6 months patient's satisfaction was assessed by modified Macnab criteria (Table 1).[14]

Table 1 Modified Macnab Criteria

Result (Outcome)	Criteria
Excellent	No pain, no restriction of mobility; return to work with good level of activity.
Good	Occasional non radicular pain, relief of presenting symptoms, able to return to modified work.
Fair	Some improved functional capacity, still handicapped and unemployed.
Poor	Continued objective symptoms of root involvement, additional operative intervention needed at the index level irrespective of length of postoperative follow - up.

Data were analyzed in the computer using SPSS for windows. Descriptive analytical techniques involving frequency distribution, computation of percentage etc. were done. In statistical analysis, outcome categories of patient satisfaction were regrouped. Excellent and good categories were considered as satisfactory, fair and poor categories were considered as unsatisfactory.

Results

A total of 20 patients, 17 (85.0%) were males and the rest 3 (15.0%) were females. The male female ratio was 5.67:1. The mean age of them was 33.2±11.8 years with a range 18-60 years. Fifty percent cases were due to road traffic accident and the rest (50.0%) were due to high energy falls. Spinal injury at the level of twelve thoracic vertebra (T_{12}) occurred in 8 (40.0%) patients, first lumbar vertebra (L_1) in 8 (40.0%)) and second lumber vertebra (L_2) in 4 (20.0%) patients. Sixty percent of the spinal injuries were compression and rest (40.0%) were burst fractures.

The pre-operative ASIA grade status of the patient's SCIs was B in 9 (45.0%), C in 10 (50.0%) and D in 1 (5.0%) patients. At the end of 6 month after operation, all the patients had improve in neurological function. In particular, a neurological improvement of 1 ASIA level was observed in 7 (35.0%) patients, 2 grade improvement in 12 (60.0%) and 3 grade improvement in 1 (5.0%) (Table 2).

Before operation mean Cobb angle and Kyphotic deformation of vertebral body and Beck Index of the present study patients were 21.3±6.9 and 23.2±4.8 degree respectively. And at the end of 6 months of operation both of them reduced to 12±3.3 and 9.5±2.3 degree respectively. Pre-operative mean Beck Index of the patients was 0.80±0.40 and at end of 6 months, it increased to 0.88±0.42.

Patients' satisfaction about the out comes of operation was excellent in 13 (65.0%), good in 6 (30.0%), fair in 1 (5.0%) study patients. Poor was not found (Table 3). A total of 20 patients, 19 (95.0%) patients

were satisfied about the outcomes of the long-segment (LS) posterior instrumentation and only one (5.0%) patient was dissatisfied about the outcomes of the operation.

Table 2 Pre and post operative status of the study patients according to ASIA grading.

Pre operative		Post operative ASIA grade (After 6 months follow up)				
ASIA Grade	Frequency N (%)	A N (%)	B N (%)	C N (%)	D N (%)	E N (%)
A	-	-	-	-	-	-
B	9 (45.0)			3(33.4)	5(55.5)	1(11.1)
C	10 (50.0)				3(30.0)	7 (70.0)
D	1 (5.0)					1 (100.0)
E	00 (00.0)					
Total N(%)	20 (100.0)			3(15.0)	8(40.0)	9(45.0)

Table 3. Patients' satisfaction after 06 months follow up according to modified Macnab criteria. n=20

Modified Macnab criteria	Frequency N	Percentage %
Excellent	13	65.0
Good	06	30.0
Fair	01	05.0
Poor	00	00.0

A total of 20 patients, only 5 patients (25.0%) developed post operative complications, among them urinary tract infection was in 3 (15%) and bed sore was in 2 (10%) patients

DISCUSSION

Thoracolumbar fractures with neurologic deficit are frequent. It is widely accepted that thoracolumbar unstable fractures should be addressed surgically. The purpose of treating vertebral fractures are the immediate mobilization of the patient with less depending of bracing, the distribution of corrective force over multiple levels and the reduction of likelihood of implant failure. The purpose of treating thoracolumbar fracture is to achieve early neurological decompression and stabilization for early rehabilitation. The pedicle offers a strong point of attachment of the posterior elements to the vertebral body. Pedicle screw fixation revolutionized spine surgery and lumbosacral instrumentation is a more effective management of thoracolumbar burst fractures either SS and LS pedicle instrumentation.15-17[13-15]. Verlaan et al.[18] eviewed 132 papers, published within a 30-year period (1970-2001), for studying the surgical outcome of this instrumentation in the management of thoracic and thoracolumbar fractures and its complications rates. Though, there are inequities as far as the severity of the injury is concerned between the different groups. Eventually, no difference found between the outcomes of patients treated with long constructs compared to them who treated with short constructs. However LS instrumentation needs more time to perform than SS instrumentation. But a low rate of complications and a very low rate of serious complications was reported among the

patients with long constructs. The present study findings also revealed that LS instrumentation is an effective intervention for the recovery of neurological function in Transient Symptoms with Infarction (TSI). Neurological recovery of one or more ASIA impairment scale was seen in all patients. More than 60% (13/20) of the study subjects had 2 grade or above improvement of neurological function in the ASIA scale at the end of 6 months of follow up period after LS instrumentation. Additionally there was no reported implant failure within the follow up period. Similar findings also noted in a study of Islam, *et al.*[2] In studies of Sapkas, G *et al.*[9] and Verlaan *et al.*[18], the radiographic indexes (Cobb angle and kyphotic deformation) were far improved after LS pedicle instrumentation. The present study findings also consistent with their observations. No remarkable difference between pre and post operative beck index was observed in this study, indicating that this index is not reliable enough for the evaluation of LS pedicle instrumentation. It goes in favor to Sapkas, G *et al.*[9]

The present study findings suggests that middle aged males are commonly prone to develop thoracolumbar spine injury, because they are supposed to be more exposed to trauma than other groups. The mean age and male female ratio of the present study subjects were 33.2±11.8 years and 5.67:1 respectively, Which correlate well with the findings of the previous studies. [19,20].

The predominant causes of (TSI) are falls from heights and road traffic accident.[5,21] Similar findings also observed in the present study.

Previous studies[2,22] revealed that according to modified Macnab criteria, functional result of LS instrumentation were excellent to good in more than 84% patients. It was 95% in the present study.

The results of this study have certain implication in clinical practice however. The study findings suggest that Long Segment Transpedicular Screw Fixation with Decompression by Laminectomy is an effective method of treatment of Thoracolumbar Spine Injuries. This method enhances anatomical, clinical and functional recovery, reduce pain and improve working status with early rehabilitation.

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