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Evaluation of outcome of posterior decompression and instrumented fusion in thoracolumbar fractures

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ABSTRACT

Background: The fractures of the thoracolumbar junction are the most common injuries of the vertebral column. Fall from a height and road traffic accidents are the main causes of injury. The present study aims to evaluate the functional, neurological and radiological outcome of the posterior decompression and instrumented fusion in operated patients with thoracolumbar fractures.
Methods: In this retrospective and prospective study, a cohort of 30 patients with thoracolumbar fractures, classified by thoracolumbar injury classification and severity (TLICS) scoring system, underwent posterior decompression and pedicle screw fixation from January 2013 to August 2018 were included. Patients were assessed functionally (ODI score), neurologically (MRC grading) and radiologically (kyphotic angle) preoperatively and at 6 weeks, 3 months, 6 months and 12 months post-operatively.
Results: The mean ODI score improved from 87.40 pre-operatively to 13.33 at final follow-up (p value 0.001). The mean kyphotic angle decreased from 24.37 degrees preoperatively to 9.87 degrees postoperatively (p value 0.001) with mean loss of correction of 1.16 degrees at final follow-up. Hip flexors and knee extensors improved from a mean preoperative value of 2.60 to 4.83 at final follow-up (p value 0.001). Similarly, ankle dorsiflexors, long toe extensors and ankle plantar flexors improved from mean preoperative value of 2.53, 2.50 and 2.60 to 3.93, 3.80 and 4.73 at final follow-up, respectively (p value 0.001).
Conclusions: Posterior decompression and instrumented fusion is a safe and effective surgical option in patients with thoracolumbar fractures. TLICS scoring system has a prognostic value and helps in determining the prognosis in these patients.

Keywords: Thoracolumbar fractures, TLICS score, Posterior decompression, Instrumented fusion

INTRODUCTION

The fractures of the thoracolumbar junction are the most common injuries of the vertebral column. Fall from height and road traffic accidents are the major causes of injury. The thoracolumbar junction (T10-L2) is uniquely positioned in between the rigid thoracic spine and the mobile lumbar spine and this transition from the less mobile thoracic spine and associated ribs and sternum to the more mobile lumbar spine causes significant biomechanical stress to the thoracolumbar region. Hence, fractures of the thoracolumbar region are the most common injuries of the vertebral column. Neurological deficit occurs in 20% to 55% patients who sustain this injury.[1]

The thoracolumbar injury classification and severity (TLICS) score appears to be the most appropriate

classification system as it not only tell us about the severity of the injury but also about the management of the injury. It is composed of three main components: morphology of injury according to radiographic features, integrity of the posterior ligamentous complex, and neurologic status of the patient. This new classification scheme accounts for predictors of spinal stability, future deformity, and progressive neurologic compromise, thereby facilitating clinical decision making.[2]

Surgical treatment is recommended for patients with progressive neurologic deficits or in those with severe instability. The main aim of surgical treatment is to decompress the spinal canal and nerve roots, realign the spine, correct and prevent development of post-traumatic kyphotic deformity, and provide long-term stability to the injured spinal segment.[1]

In thoracolumbar fractures, either anterior or posterior approach can be used, or combined approach can be performed for fixation and decompression. However, posterior approach is less extensive, and most spine surgeons advocate posterior fusion as the treatment of choice for unstable thoracolumbar fractures. Stable fixation is achieved by pedicle screws as the screws traverse all the three columns.[3] Pedicle instrumentation has become a popular method since Dick et al introduced the "fixateur interne" device.[4]

The present study aims to evaluate the functional, neurological and radiological outcome of the posterior decompression and instrumented fusion in operated patients with thoracolumbar fractures.

METHODS

A total of 30 patients with thoracolumbar fractures were diagnosed and operated between January 2013 and August 2018 at Sri Aurobindo Institute Of Medical Science, Indore. The diagnosis was made on the basis of history, clinical examination, antero-posterior and lateral radiographs, and MRI of the thoracolumbar spine. Fractures were classified on the basis of TLICS scoring system (Table 1). All the patients included in the study, had severe back pain and/or neurological deficit with TLICS score of 5 or more and hence underwent posterior decompression and pedicle screw fixation. None of the patient had history of trauma older than 7 days. Patients with concomitant fractures of any region other than thoracolumbar spine or with any pathological fracture of thoracolumbar spine were excluded from the study. Online software like graph pad, Epi tools etc. were used for statistical analysis.

Preoperative workup

All patients underwent routine blood investigations, radiographs and MRI of thoracolumbar spine. Pre-anesthetic evaluation was done for all cases.

Operative technique

All patients underwent surgery in prone position under general anesthesia. A standard posterior midline incision was taken. The desired levels were subperiosteally exposed and pedicle screws were fixed under image intensifier guidance. Laminectomy and decompression was done of the affected level. Reduction was achieved through a combination of postural reduction and ligamentotaxis.

Postoperative care

Log roll, side turning were started on postoperative day 1, and mobilization with the support of Taylor's brace was started as early as possible. Parenteral antibiotics were given till second post-operative day and then oral antibiotics till fifth day. On the second post operative day, wound inspection and dressing was done. Suture removal was done on fourteenth day except in one patient with superficial infection; suture removal was delayed to 20th day in that patient.

Radiological outcome (by kyphotic angle), functional outcome (by Oswestry disability index), and neurological outcome (by MRC grading) were assessed preoperatively and at 6 weeks, 3 months, 6 months and 12 months post-operatively.[5-7] Kyphotic angle was measured as the angle between the caudal and cephalic end plates nearest to the fractured vertebra.

Table 1: The TLICS score.[2]

Parameters		Points
Morphology of fracture	Compression	1
	Burst	2
	Translational or rotational	3
	Distraction	4
Neurological involvement	Intact	0
	Nerve root compression	2
	Cord transection-complete	2
	Cord transection-incomplete	3
	Cauda equina	3
Posterior ligamentous complex	Intact	0
	Intermediate	2
	Injured	3

RESULTS

There were 16 male and 14 female patients and the mean age of cohort was 35.19 years (range 18-80 years). The indications for surgery were severe back pain, neurological involvement and three column injury.

Out of 30 patients, 15 patients had fracture at T12 and 14 patients had fracture at L1 and 1 patient had fracture at both levels.

The mean ODI score improved from 87.40 pre-operatively to 13.33 at 12 months follow-up (p value 0.001) (Table 2).

The neurological recovery was statistically significant in all muscle groups at 12 months follow-up. Hip flexors and knee extensors improved from a mean preoperative value of 2.60 to 4.83 at final follow-up (p value 0.001). Similarly, ankle dorsiflexors, long toe extensors and ankle plantar flexors improved from mean preoperative value of 2.53, 2.50 and 2.60 to 3.93, 3.80 and 4.73 at final follow-up, respectively (p value 0.001) (Table 3).

There was mean correction of kyphotic angle from 24.37 degrees pre-operatively to 9.87 degrees post-operatively (p value 0.001). The mean loss of correction at final follow-up was 1.16 degrees (p>0.05) (Table 4).

Table 2: ODI score preoperatively and at 12 months follow-up (n=30).

Time period	No.	Oswestry disability index (mean±SD)	't' value	P value
Preoperative	30	87.40±5.88	7.023, df=29	0.001*
12 months	30	13.33±10.98		

Paired 't' test applied. P<0.05 was taken as statistically significant.

Table 3: Neurological recovery in various muscle groups at 12 months follow up (n=30).

Muscle groups	Time period	Mean±SD	"t" value	P value
Hip flexors	Pre operative	2.60±1.30	-10.242, df=29	0.001*
	12 month follow up	4.83±0.38		
Knee extensors	Pre operative	2.60±1.30	-10.242, df=29	0.001*
	12 month follow up	4.83±0.38		
Ankle dorsiflexors	Pre operative	2.53±1.28	-10.592, df=29	0.001*
	12 month follow up	3.93±1.08		
Ankle plantar flexors	Pre operative	2.60±1.30	-10.016, df=29	0.001*
	12 month follow up	4.73±0.78		
Long toe extensors	Pre operative	2.50±1.28	-9.497, df=29	0.001*
	12 month follow up	3.80±1.03		

Paired 't' test applied. *P<0.05 was taken as statistically significant.

Table 4: Comparison of Kyphotic angle at different time periods (n=30)

Time Period	Kyphotic angle (mean±SD)	't' value	P value
Preoperative	24.37±8.80	11.810, df=29	0.001*
Immediate post operative	9.87±5.99		
Immediate post operative	9.87±5.99	1.16, df=29	0.255*
12 months post operative	11.03±5.51		

Paired 't' test applied. *P<0.05 was taken as statistically significant.

There was one complication of superficial infection in our study which got better with antibiotics alone. Two patients had instrumentation related complications in the form of implant failure. One patient had broken rod on radiographs but no neurological deficit. He was advised implant removal but patient lost to follow-up. Another patient had hardware impingement and pain for which he underwent implant removal surgery. Intra-operatively, one screw was found to be broken in that patient.

Case details

Case 1: 35 year male with history of road traffic accident. Preoperative radiograph shows L1 vertebra fracture. Preoperative TLICS score was 5 with kyphotic angle of 26 degrees. Posterior decompression and pedicle screw fixation was done and at 12 months post op, the kyphotic angle was 14.6 degrees.

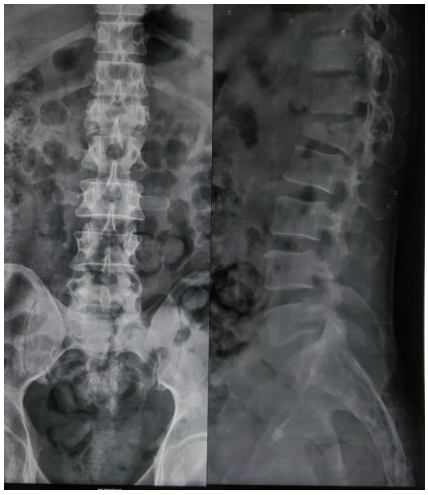

Figure 1: Pre op X-ray.

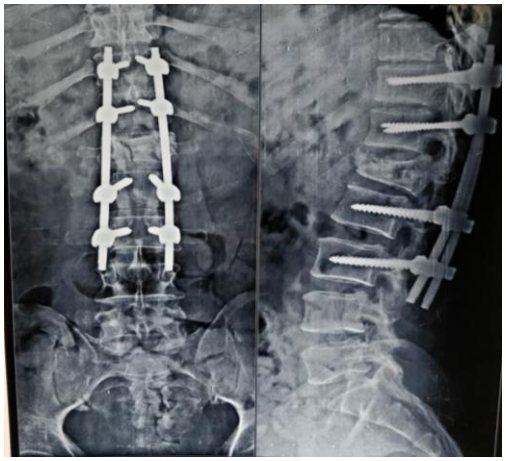

Figure 2: 12 month post op X-ray.

Case 2: 36 year female with history of fall from height. Preoperative X-ray shows L1 vertebra fracture. Preoperative TLICS score was 6 with kyphotic angle of 30 degrees. Posterior decompression and pedicle screw fixation were done and at 12 months follow up, the kyphotic angle was 8 degrees.

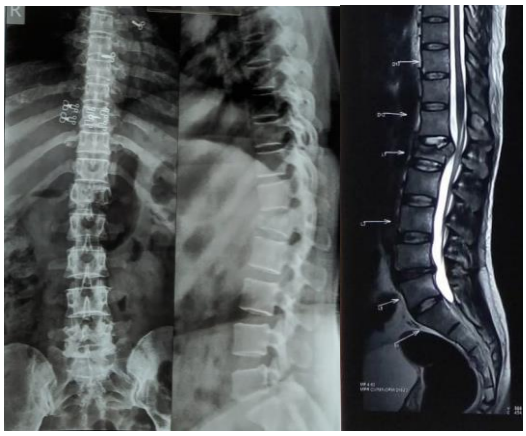

Figure 3: Pre op X-ray and MRI.

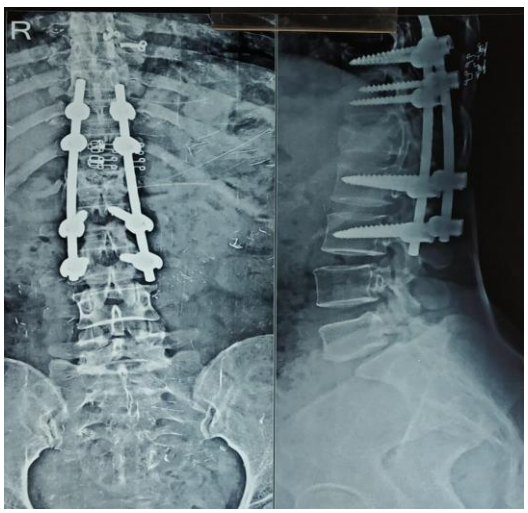

Figure 4: 12 months post op X-ray.

DISCUSSION

Fractures of thoracolumbar spine are common injuries. About 50% of these injuries are unstable and may lead to significant morbidity and disability. The incidence of neurological deficit has been reported in various studies and ranges from 20% to 55%.[8-10]

Various classification systems have developed and evolved over time. Initial classification systems were based on radiographs only. Denis described "three column concepts" with middle column as the key to stability of the fracture. McAfee also described a simple classification system based on injuries commonly seen in clinical practice. However, no classification system helps in guiding treatment. TLICS system, based on three major characteristics, appears to be the most promising classification system that not only tells about the severity of the injury but also helps in guiding the treatment.[11]

The treatment of thoracolumbar fractures aims at restoration of the anatomical integrity and structural stability of the injured spine. Stable fractures (compression fractures and stable burst fractures without neurological deficit) can be managed conservatively. However, unstable fractures with or without neurological deficit have reported better outcome with surgical management.[12]

Surgical approach in thoracolumbar fractures depends on various factors. Fracture morphology, neurological status, surgical morbidity to the patient, complications rates, cost and surgeon preference all play major roles in deciding the surgical approach.

Anterior approach to thoracolumbar spine allows for direct exposure and decompression of the neural contents and provides strong load bearing support to the spine and thus avoids progressive vertebral collapse and kyphosis. However, anterior approach has been found to be more invasive, technically more demanding and associated with higher rate of complications like hemopneumothorax, respiratory tract infection, intercostal neuralgia, abdominal distension and constipation.[13,14]

Combined anterior and posterior approach may be beneficial in select patients with thoracolumbar fractures. The advantages of combined surgical approaches are improved sagittal alignment, thorough spinal canal and neural decompression and stabilization of the disrupted posterior ligamentous complex (PLC).[11] But certain disadvantages like longer operative times, greater blood loss and higher costs along with the complications associated with anterior approach makes it technically more demanding, less feasible and adds up to the approach related surgical morbidity.[15]

Posterior pedicle screw fixation has been shown to be simple, familiar, efficient, reliable and the most popular technique for reduction and fixation of thoracolumbar fractures. Reduction can be achieved through a

combination of postural reduction and ligamentotaxis.[11] Disadvantages include pseudarthrosis, infection, risk of implant failure, injury to neural structures, inadequate neural decompression, insufficient correction of kyphosis and need for late instrumentation removal.[11]

Posterior approach works on the principle of indirect decompression. Although, it has been reported that anterior approach allows for better neural decompression and canal remodeling, the recovery of neurological function did not depend on the extent of spinal decompression and canal encroachment.[15]

The chances of progression of kyphosis and implant failure are more in fractures with severe vertebral comminution and significant kyphotic deformity. Anterior surgery decreases the chances of progression of kyphosis and implant failure in such cases. However, techniques such as addition of intermediate screw into the fractured vertebra, use of cross-links, intracorporeal filling of hydroxyapatite or calcium phosphate, kyphoplasty and vertebroplasty has been shown to increase the biomechanical strength of short segment pedicle screw construct and thus helps in reducing the risk of progression of kyphosis and implant failure.[11,16,17]

Long segment instrumented fusion that includes two or more levels above and below the injured segment, is another technique that can preserve and restore coronal and sagittal stability, prevent recurrent kyphosis, promote fusion and post-reduction stability, and decrease the incidence of implant failure. Though long segment construct sacrifices the motion of the normal mobile segment, it is techanically less demanding and more feasible, and avoids the complications and risks of anterior approach.[13]

Our study aims at evaluating the functional, neurological and radiological outcome of posterior decompression and pedicle screw fixation in patients with thoracolumbar fractures with TLICS score 5 or more.

In our study, we observed that the recovery of motor deficit in proximal muscle groups (hip flexors, knee extensors) was better as compared to distal muscle groups (ankle dorsiflexors, long toe extensors, ankle plantar flexors) at 12 months post operatively, achieving near normal motor strength ($p<0.001$).

The motor recovery in patients with TLICS score 5 was better and statistically significant than in patients with TLICS score 6 ($p<0.05$). On the other hand, the motor recovery in patients with TLICS score 6 when compared to patients with TLICS score 7 was not statistically significant ($p>0.05$) means, patients with TLICS score of 5 had better neurological outcome as compared to patient with TLICS scores of 6 or 7.

So, it can be inferred from our study that proximal muscles weakness and lower TLICS score are associated with better neurological outcome at 12 months follow-up.

In our study, the mean correction of kyphotic angle was from 24.37 degrees preoperatively to 9.87 degrees immediate postoperatively with mean loss of correction of 1.16 degrees at 12 months following surgery. The results of our study are in accordance of the available literature. Srinivasan et al in their study reported a mean correction of kyphotic angle from 24.3 degrees preoperatively to 7.3 degrees postoperatively and it remained same till last follow-up.[5]

Similar results have been reported by Adawi et al in their study of 36 patients.[18] The mean correction of kyphotic angle was from 33 degrees preoperatively to 12.8 degrees immediate post operatively and 17.1 degrees at 1 year follow-up. Two patients had implant failure in our study with a failure rate of 6.66%. Srinivasan et al has reported a failure rate of only 5.8% in their study and hence our study has results comparable to the available literature.[5]

Small cohort of patients and short follow-up period are few limitations of our study. Studies with large cohort and longer follow-up may be needed to validate the results of posterior decompression and instrumented fusion in thoracolumbar fractures.

CONCLUSION

Single-stage posterior decompression and instrumented fusion is an effective and safe procedure for surgical treatment of thoracolumbar fractures. TLICS system has a prognostic value and helps in determining the prognosis in patients with thoracolumbar fractures.

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Ethical approval: The study was approved by the institutional ethics committee

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