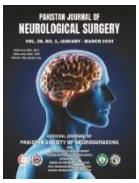

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Original Research

Efficacy of Short-Segment Transpedicular Fixation for Thoracolumbar Fractures in Terms of Improvement in Neurological Status

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ABSTRACT

Objective: To determine the efficacy of short-segment transpedicular fixation for thoracolumbar fractures in terms of improvement in neurological status.

Materials and Methods: A prospective observational research was conducted at Bacha Khan Medical Complex, Swabi, Section of Neurosurgery. Patients having traumatic thoracolumbar fractures with neurological deficits were subjected to short-segment transpedicular fixation and evaluated for post-operative improvement in neurological status at a 6-month follow-up.

Results: 48 patients participated in the study. Mean age was 35.69±8.22 years and 60.4% were males. History of falls was the most common mechanism responsible for spinal injury i.e. 56.3%. D12 vertebra was fractured in 43.8% of patients. The leading type of fracture was, AO type B in 37.5% of patients. 23 (47.9%) of the patients showed one or more grade improvements in their neurological status on the ASIA scale at 6-month follow-up. Surgical site infection was the common postoperative complication (8.3%).

Conclusion: Short-segment transpedicular fixation is an effective procedure for traumatic thoracolumbar fractures in terms of improvement in neurological status.

Keywords: Short-segment; Transpedicular fixation; Thoracolumbar fractures;

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INTRODUCTION

Spinal trauma can result in the vertebral column, spinal cord, nerve roots, ligaments, and disc injury.[1] The incidence of spine injury secondary to trauma is estimated to be 10.5 cases per 100,000 population and results in approximately 768,473 cases annually worldwide. The incidence is relatively higher in low and middle-income nations in contrast to high-income nations (8.72 Vs.13.69 cases per 100,000 population).[2] Similarly, the

incidence rate of spinal cord injury (SCI) secondary to traumatic spine injury ranges from 8 to 246 cases per million population and prevalence varies from 236 to 1298 cases per million population.[3] The finances required for immediate in-hospital management and later for rehabilitation purposes are very high.[4,5,6] One study in the United Kingdom reported an estimated cost of a mean of £1.12 million per SCI case.[7] Road traffic accidents (RTA) and high or low falls are the leading causes of spinal injury, whereas RTA and high falls are common in the younger population and low falls are usually responsible for spinal injury in the older population.[8]

Among all the traumatic spinal fractures, the thoracolumbar region is the most commonly affected and ranges from 67-80% among all spinal fractures; however, thoracic fractures have relatively worse neurological grades on assessment.[9,10,11] Due to spinal instability and the compressive nature of the thoracolumbar fractures, it can result in significant neurological deficit and long-term morbidity and mortality if not managed in time. The aim is to reduce and stabilize the fracture, decompress the neural elements, and restore the angular deformity.[11,12]

Thoracolumbar fractures with neurological deficits should be treated with surgical decompression and stabilization; however, the choice between posterior (Transpedicular fixation and decompression) and anterior (Carpectomy and fusion) remained a matter of debate for some time.[13,14] As recent studies have confirmed that the posterior approach has comparable results with the anterior approach in most cases and relatively fewer complications, it should be adopted as a procedure of first choice.[14,15,16] Timings of surgery (early Vs. late) and short-segment vs long-segment fixation are a few other topics of discussion in this connetion.[17,18]

We conducted this study to find out the neurological improvement in patients with traumatic thoracolumbar fractures with neurological deficits after undergoing short-segment transpedicular thoracolumbar fixation and decompression.

MATERIALS AND METHODS

Study Design and Setting

The two-year study i.e. 1st August 2021 to 31st July 2023 was carried out at Bacha Khan Medical Complex, Swabi, Department of Neurosurgery. This was prospective observational research.

Inclusion Criteria

Patients aged 20-60 years of both genders, with a history of traumatic thoracolumbar fractures (D11-L2) and neurological deficit (ASIA Scale ≤ D) who underwent transpedicular fixation were included.

Exclusion Criteria

Patients who had traumatic thoracolumbar fractures and were neurologically intact (ASIA scale = E) were not included. Those who had a thoracolumbar fracture secondary to a pathological process or osteoporosis were also excluded. Patients with a previous history of surgery to the thoracolumbar spine were also dropped out. Patients who had any neurological deficit due to other causes i.e. stroke or tumors before having a traumatic thoracolumbar fracture were also removed from the study.

Data Collection

Before the commencement of the research, approval was obtained from the hospital's ethical and research approval committee. All the patients in the study were recruited Via the Accident and Emergency Department utilizing the above-stated inclusion criteria and informed consent was gained from them. Neurological status was determined with the help of the ASIA Scale mentioned below. Radiological assessment was done with the help of a plain X-ray dorsolumbar spine and CT scan and

classified using the AO spine dorsolumbar fracture classification system. Subsequently, the patients were subjected to short-segment transpedicular fixation as detailed below. The neurological status of the patients was re-assessed at the 6th-month follow-up and documented. A follow-up radiological assessment was done with the help of a plain X-ray dorsolumbar spine. Data was collected with the help of a questionnaire and stored in a Microsoft Excel database.

Surgical Steps

After induction of General anesthesia, the patients were positioned in a prone followed by skin incision and soft tissue dissection. The pedicles were identified utilizing the knowledge of anatomical landmarks and confirmed with the help of an image intensifier. Transpedicular screws were passed at index level i.e. fractured vertebra and a level above and below, followed by rod fixation and closure of all the layers in reverse order.

Assessment of Neurological and Radiological Status

Pre- and post-operative neurological status at 6-month follow-up was determined with the ASIA scale and pre-operative radiological classification was done utilizing the AO spine dorsolumbar fracture classification system.

Data Analysis

Data including age, gender, mode of trauma, neurological status, radiological classification, and post-operative complications was collected via a proforma and analyzed with SPSS 26. Pre- and post-operative neurological status on the ASIA scale and improvement in neurological status were compared with a chi-square test.

RESULTS

Age Distribution

The total number of participants was 48. The mean age was 35.69±8.22 years (range = 21-58 years).

Gender Distribution

The study included 29 (60.4%) male and 19 (39.6%) female patients.

Mechanism of Spinal Injury

Most of the patients had a history of falls followed by road traffic accidents. The details are shown below in Table 1.

Table 1: Mechanism of injury.

Mechanism of Injury	No. of Patients	Percentage
History of fall (HOF)	27	56.3%
Road traffic accidents (RTA)	17	35.4%
Firearm injury (FAI)	2	4.2%
Physical Assault (PA)	2	4.2%

Level of Spine Injury

The most common level was D12 followed by L1. The details are shown in Table 2.

2: Level of Spinal Injury.

Level of Injury	No. of Patients	Percentage
D11	4	8.3%
D12	21	43.8%
L1	17	35.4%
L2	6	12.5%

Classification of Fractures

The most common type was AO type C. The details are shown in Table 3.

Pre- and Post-operative Neurological Status

The pre-and post-operative neurological status

was determined by the ASIA scale as shown in Table 4 and compared with the Chi-square test which revealed statistically significant differences in pre-and post-operative patients (P-value= 0.03).

Table 3: AO Classification of Fractures.

AO Classification	No. of Patients	Percentage
AO Type A	6	12.5%
AO Type B	18	37.5%
AO Type C	24	50%

Table 4: Pre- and Post-operative Neurological Status.

Neurology	Pre-operative No.	Percentage	Post-operative No.	Percentage	Total	P-value
ASIA A	19	39.6%	17	35.4%	36	0.002
ASIA B	07	14.6%	4	8.3%	11	
ASIA C	12	25.0%	4	8.3%	16	
ASIA D	10	20.8%	11	22.9%	21	
ASIA E	0	0%	12	25.0%	12	
Total	48	100%	48	100%	96	

Table 5: Post-operative Improvement in Neurology.

		Status		Total	P-value
		Pre-operative	Post-operative		
Improvement	Yes	0	23	23	0.00
	No	48	25	73	
Total		48	48	96	

Post-operative Improvement in Neurological Status

At the 6-month follow-up, 23 (47.9%) of the patients showed improvement in neurological status while 25 (52.1%) showed no improvement. The pre-and post-operative neurological status was compared with the chi-square test as shown in Table 5 there was a statistically significant improvement in neurological status (P-value = 0.00). The details are shown below in Tables 5 and 6.

Table 6: Grade of Improvement.

Improvement	No. of Patients	Percentage
No improvement	25	52.1%
1 Grade	17	35.4%
2 Grade	3	6.3%
3 Grade	3	6.3%

Complications

The common post-operative complication was surgical site infection. The details are shown in Table 6.

Table 6: Complications.

Complications	No. of Patients	Percentage
Surgical site infection	4	8.3%
CSF leak	1	2.1%
Implant failure	2	4.2%
Fusion failure	2	4.2%
Neurological deficit	0	0%

DISCUSSION

According to the latest WFNS spine committee findings the incidence rate of thoracolumbar fracture is around 30 cases per 100,000 population and road traffic accidents are the leading cause in developing countries like Pakistan; however other etiologies may include the history of falls, gunshot wounds, and sport injuries.[19] Although the treatment of choice is surgery, the controversy of

short-segment vs. long-segment fixation and inclusion and exclusion of fractured vertebra in the fixation still exists.[20] We performed short-segment transpedicular fixation with the inclusion of the fractured vertebra accompanied by decompression to assess the improvement in neurological status.

The mean age in our study was 35.69±8.22 years with 60.4% of the patients being male. El Behairy et al,[21] reported a mean age of 36.75 years and male to female ratio of 3 to 1. Similarly, Deng WX et al,[22] found that the mean age was 36 years and 19 were males and 8 were females. These findings suggest that thoracolumbar fractures are common in relatively young and healthy individuals especially males because a greater number of them are involved in road traffic accidents and sports injuries. Secondly, it also reflects that such injuries can not only have a financial impact on the families of the patients but overall, on society as these young people contribute a lot to the overall financial support of their families and societies.

History of falls was the leading cause of trauma followed by road traffic accidents in our study (56.3% and 35.4% respectively). Li et al,[23] reported similar findings that fall was the leading cause in 43.2% of patients and motor vehicle accidents were responsible for 17.4% of cases. Charles et al,[24] revealed road traffic accidents as the most common cause followed by falls (45% vs. 30%).

We found that the most common vertebra fractures were D12 and L1 (43.8% and 35.4% respectively) and 50% of the patients had AO type C fractures. Razaq et al,[25] reported L1 as the most common fractured vertebra and 51.3% of the patients had AO type C fracture. Rehman et al. [26] also reported L1 (41.94%) as the most common fractured vertebra.

In our pre-operative assessment, 39.6% of the patients were in the AISA A group followed by 25% in ASIA C while there were no patients in ASIA E as we excluded patients with intact neurology from the study. Post-operatively, at 6-month follow-up, 47.9% of the patients showed improvement in neurological status, with 35.4% showing one grade, 6.3% showing two grades, and 6.3% showing 3 grades improvement on the ASIA scale. Similarly, Razaq MN et al,[25] reported that 43.6% of patients were in ASIA A and 39.6% were in ASIA C, pre-operatively while 45% of the patients showed improvement in neurology by one or more grades on the ASIA scale. Ramírez-Villaescusa J et al,[27] compared the neurological improvement in thoracolumbar fractures in those patients who underwent surgical intervention either less or more than 8 hours after the injury and reported that those operated early had a statistically significant improvement (1.73 Vs. 0.47 as mean improvement score), though we did consider timings of surgery in our study and included all the patients who fulfilled the inclusion criteria irrespective of the time since trauma status. This might have added a bias to our results. Similarly, Butt MF et al,[28] reported an improvement in 24 patients of one or more grades out of 50 patients who underwent short-segment fixation for thoracolumbar fractures.

We did not find any post-operative neurological deterioration in any case and only two patients followed up with implant failure who underwent revision surgery. Surgical site infection was the common complication (8.3%); however, the complication rates were acceptable and according to the international standards as were likely reported in other studies.[21-28]

CONCLUSION

Our study concluded that short-segment transpedicular fixation is an effective procedure for traumatic thoracolumbar fractures and can result in improvement in neurological status. Because of the above findings, it is recommended as the procedure of choice for traumatic thoracolumbar fractures.

LIMITATIONS AND RECOMMENDATION

We did not consider the time elapsed between trauma and surgical intervention which might have introduced bias in our study and had a relatively smaller sample size to make any recommendations; therefore, further studies with the above considerations and larger sample size are recommended to reduce the bias in the results.

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Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.
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Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.
Data Sharing Statement: For data sharing, interested researchers can contact the corresponding authors.

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Sajjad Ahmad	1. Study design, methodology, data collection & paper writing.
2.	Mian Iftikhar ul Haq	2. Analysis of data, literature review, interpretation of results, and editing.