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Clinical and Radiological Assessment of Interbody Fusion and Short-Segment Fixation in Dorso-Lumbar Fractures

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ABSTRACT

Background: Spine fractures account for a large portion of musculoskeletal injuries worldwide. Approximately 75% to 90% of spinal fractures occur in the thoracic and lumbar spine, with most of these occurring at the thoracolumbar junction (T10-L2). Surgical treatment has demonstrated better clinical and radiological results than conservative treatment. **Objective:** To evaluate the outcome of short-segment fixation with interbody fusion in dorsolumbar fractures clinically and radiologically**.**

Patients and Methods: This study took place at the Neurotrauma Unit of Neurosurgery Department, Zagazig University Hospitals. It included sixteen patients with thoracolumbar fractures treated by short-segment open transpedicular posterior fixation with interbody fusion.

Results: Male was the predominant sex (68.7%), mean age was 37.88 years (range: 19-55 years) and the residence in rural areas was 50 % and in urban areas was 50 %. Housewives were the predominant occupation and constitute 31.3%. 81.3% of patients were married. The most prevalent AO spine type of fracture was A3 fracture where it constituted 62.5% of patients, the level of fracture was L2 in 50 % of patients & about 38% had severe pain as reported on VAS score. In our Study there was significant change in ASIA score 12 weeks postoperatively. While 62.5% had E score preoperatively, 87.5% had it 12 weeks postoperatively and 12.5% turned had score C 12 weeks preoperatively versus no one postoperatively had C ASIA score.

Conclusion: Surgical treatment of thoracic and lumbar fractures allows for immediate stabilization of the spine, restoration of sagittal alignment, and the possibility of spinal canal decompression.

Keywords: Dorso-Lumbar Fractures- Interbody Fusion- Short Segment Fixation.

INTRODUCTION

Thoracolumbar junction has unique anatomical and biomechanical features because this region is a transition region from kyphotic thoracic segment to lordotic lumbar segment just like other junctional regions such as cervicothoracic and lumbosacral region. The term of thoracolumbar junction is generally defined as a region from T10 to L2 vertebral bodies [(1)]**.** Although in elderly patients the thoracolumbar inflexion point migrates caudally includes third lumbar vertebra because of their increased degree of thoracic kyphosis [(2)]**.** Thoracolumbar fractures represents nearby 70% of all traumatic spine fractures. Traffic accidents, fall from height or sport accident are the causes of the majority of these fractures [(3)]**.**

There is several classification systems of traumatic thoracolumbar fractures aiming to provide an accepted treatment algorithm in such cases [(4)]**.** Dennis' classification is the first determined and simple classification system to understand the mechanism of trauma and trauma related pathologies. The basic concept has been constructed on the middle column. If there is an injury in the middle column, spine should be considered as unstable and surgery would be necessary [(5)]**.** Management of traumatic thoracolumbar factures is dependent on an accurate assessment of spinal stability, a concept defined by the integrity of the spine and its supporting structures as well as the neurologic status of the patient [(6)]**.** Progressive neurological deterioration is generally considered an absolute indication for early surgery, when neural decompression is performed, neurological recovery has been observed. Other strong indications for surgical intervention includes incomplete neurological deficit, more than 25 to 30 angle of kyphotic deformity, more than 50% loss of vertebral body height and more than 50% of canal narrowing [(7)]**.**

The two main goals of surgery for traumatic thoracolumbar fractures are to adequately decompress the spinal canal, maximizing the neurological recovery and creating spinal stability to prevent painful deformity and potential future neurological deficit. Surgical reconstruction of fractured vertebrae provides stabilization and allows early mobilization, thus it prevents the sequel of prolonged bed rest. The surgery is generally conducted with posterior (long-segment or short-segment with fusion), anterior or anterior-posterior approaches [(8)]**.**

The study aimed to assess clinical and radiological outcome of dorsolumbar fractures after doing interbody fusion of involved fractured motion segment with short segment fixation.

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PATIENTS AND METHODS

Site of the study: The study was non-randomized clinical trial performed at the Neurotrauma Unit of Neurosurgery Department, Faculty of Medicine, Zagazig University Hospitals, Sharkia, Egypt.

Sample size and sampling frame: 16 patients with traumatic thoracolumbar fractures were collected from June 2019 to March 2020.

Patients included in the study: 16 patients with traumatic thoracolumbar fractures were treated by short segment open transpedicular posterior fixation. The patients were informed about the safety, presumed benefits and cost of the technique and were allowed to choose.

Operational design: All the patients in this study were operated at Zagazig University Hospital, Neurosurgery Department under supervision of our senior staff regard to best decision-making consultation depends on clinical and imaging assessment of each patient.

Ethical approval and patient consent:

An approval of the study was obtained from Zagazig University academic and ethical committee. Every patient signed an informed written consent for acceptance of the operation.

Pre-operative assessment:

- **Full medical history**:
- **Clinically**: systematic and neurologic assessment with regards to **ASIA classification** and impairment scale. Patient VAS for pain.

The ASIA standards defined the neurological levels and the extent of the injury (utilizing the Frankel Scale) to achieve greater consistency and reliable data among centers participating in the National SCI Statistical Center Database. The Frankel Grade classification provides an assessment of spinal cord function and is used as a tool in spinal cord injury as shown in table (1).

Table (1): The Frankel Grade classification

A complete)	No motor or sensory function is preserved in the segments.
B (incomplete)	Sensory (but not motor) function is preserved below the neurological level.
C (incomplete)	Motor function is preserved below the neurological level and the motor power is less than 3.
D (incomplete)	Motor function is preserved below the neurological level and the motor power is more than 3.
E (normal)	Motor or sensory function are normal.

- **Laboratory investigation:** General laboratory investigations e.g. complete blood count (CBC), Prothrombin time (PT), partial thromboplastin time (PTT), international normalized ratio (INR), liver function test (LFT), kidney function test (KFT) and viral markers.

- **Imaging assessment :**
  - Plain X-ray.
  - X-ray Dorsolumbar spine (AP view and Lateral view).
  - CT scan on Dorsolumbar spine.
  - MRI scan of Dorsolumbar spine.

Operative technique (for open posterior transpedicular screw fixation):

All the patients were operated by open surgery via posterior short-segment with interbody fusion by TLIF method. Operative time was calculated at end of surgery. The weight of the tissues and sponges that was used for cleaning was measured before and after the surgery. Also, the amount of blood in suction containers was estimated at end of surgery.

At the end of surgery, Blood loss was estimated by calculating the difference in weight of the tissues (sponges) used for cleaning before and after the procedure in addition to the amount of blood collected in the suction bag intraoperatively**.** Operation time was calculated from start time of skin incision till end time of wound closure. No intraoperative complications occurred in our surgeries.

Postoperatively (0-3 days after surgery)

Patients during hospital stay were assessed as regards:

1) Clinically:

- **Neurological state:** Regarding ASIA classification and patient VAS. The patients were ambulated 24 hours after surgery.
- **Surgical wound evaluation:** Regarding wound infection, CSF leakage and drain removal 24 hours after surgery.

2) Radiologically:

- **X-ray on Dorsolumbar spine (Lateral view) :** done in all cases for spinal alignment after fixation and measure angle of kyphosis using cobb's method immediate after surgery
- **CT scan on Dorsolumbar spine (Axial and sagital recontraction view):** done in all cases to evaluate Pedicle violation and screw malposition.

Follow up visits

- **2 weeks after surgery:** it's a routine visit for all cases for stitches removal and surgical wound evaluation.
- **12 week after surgery:** Clinical assessment: ASIA score and patient VAS. Radiological assessment: **X-ray** dorso-lumbar spine to re-measure Cobb's angle. **CT scan** dorso-lumbar spine (Axial and sagittal reconstruction view) to evaluate system failure if present e.g. **(**screw breakage, screw pullout, rod breakage, rod slippage, cross link slippage and cap loosening) and to assess spinal fusion.

Statistical Analysis

Data were checked, entered and analyzed using SPSS version 23 for data processing. The following statistical methods were used for analysis of results of the present study. Data were expressed as number and percentage for qualitative variables and mean ± standard deviation (SD) for quantitative one. The comparison was done using: The student "t" test. Chi- square test (X2): Level of significance: For all above-mentioned statistical tests done, the threshold of significance was fixed at 5% level (P-value).

RESULTS

Age of patients ranged from 19 to 55 years with a mean of 37.88 years old. Male constituted 68.7% of them, half of them came from rural area and 81.3% were married. About one third of them were homemaker (Table 2).

About 38% had severe pain as reported on VAS score and 63% had E ASIA score. Half of patients had fracture at L2 level and 62.5% had fracture type A3 (Table 3).

Screws number ranged from 4 to 6 with mean 4.5. All were fixed by Atlantis system with cage and bone. Operative time ranged from 120 to 180 minutes with mean 151.25 minutes. Intraoperative blood loss ranged from 200 to 500 ml with mean 334.38 ml (Table 4).

There was statistically significant change in ASIA score 12 weeks postoperatively. While 62.5% had E score preoperatively, 87.5% had it 12 weeks postoperatively and 12.5% turned had score C 12 weeks preoperatively versus no one postoperatively had C ASIA score (Table 5).

All the studied patients had accepted laboratory findings pre and postoperatively (Table 6).

Table (2): Distribution of the studied patients according to demographic data

Demographic data	**N=16 (%)**
Age ears): Mean ± SD	37.88 ±11.999
Gender:	
Female	5 (31.3)
Male	11 (68.7)
Residence:	
Rural	8 (50)
Urban	8 (50)
Marital status:	
Married	13 (81.3)
Single	3 (18.7)
Occupation:	
Housewife	5 (31.3)
Worker	3 (18.8)
Farmer	2 (12.5)
Car driver	1 (6.3)
Doctor	1 (6.3)
Employee	2 (12.5)
Student	2 (12.5)

Table (3): Preoperative clinical evaluation of the studied patients

	N=16 (%)
VAS:	
No pain	**0 (0)**
Mild	**0 (0)**
Moderate	10 (62.5)
Severe	6 (37.5)
ASIA score:	
0 (0)	
A	**0 (0)**
B	2 (12.5)
C	4 (25)
D	10 (62.5)
E	
Level of fracture:	
0 (0)	
D10	**0 (0)**
D11	2 (12.5)
D12	6 (37.5)
L1	8 (50)
L2	
Type of fracture:	
0 (0)	
A1	**0 (0)**
A2	10 (62.5)
A3	6 (37.5)
A4	0 (0)
B1	0 (0)
B2	0 (0)
B3	0 (0)
C	

Table (4): Operative data of the studied patients

	N=16 (%)
Number of screws Mean ± SD	4.5 ± 0.894
System of fixation: Atlantis	16 (100)
Type of fixation: Cage and bone	16 (100)
Operative time (minutes): Mean ± SD	151.25 ± 22.174
Blood loss (ml): Mean ± SD	334.38 ± 106.017

Table (5): Change in ASIA score pre and postoperatively among the studied patients

ASIA score	Preoperatively	12 weeks postoperatively	Wx	p
	N=16 (%)	N=16 (%)		
C	2 (12.5)	0 (0)		
D	4 (25)	2 (12.5)	-2.449	0.014*
E	10 (62.5)	14 (87.5)		

WX: Wilcoxon signed rank test *p<0.05 is statistically significant

Table (6): Imaging evaluation 3 days and 12 weeks postoperatively

Imaging evaluation	N=16 (%)
Accepted screws position	16 (100)
Postoperative 12 (weeks), good fusion	16 (100)

DISCUSSION

This study was conducted as a prospective clinical trial study in Zagazig University Hospital during the period between June 2019 to March 2020 and aimed to evaluate outcome of short-segment fixation with interbody fusion clinically and radiologically in cases of traumatic dorsolumbar fractures.

This study included cases of single level traumatic dorsolumbar fractures aged between 19 y to 55 y and excluded those with pathological fractures (susceptibility of infection or tumor) and those with previous history of thoracolumbar posterior fixation.

In this study, male was the predominant sex (68.7%), mean age was 37.88 years (range: 19-55 years). The residence in rural areas was 50 % while in urban areas 50 %. Housewife was the predominant occupation and constituted 31.3% and 81.3% of patients were married.

The most prevalent type of fracture was A3 fracture where it constituted 62.5% of patients, the level of fracture was L2 in 50 % of patients & about 38% had severe pain as reported on VAS score. We agree in this with **Hwang *et al.*** [9] who evaluated the radiological and functional results in 74 patients who had undergone a short-segment pedicle screw fixation. They were divided into two groups: group 1 (39 patients) was the non-fusion group; group 2 (35 patients) was the fusion group. In the fusion group, males were the predominant 57% of patients. Mean age was 40.5 ± 12.7 years.

In our study, there was statistically significant change in ASIA score 12 weeks postoperatively. While, 62.5% had E score preoperatively, 87.5% had it 12 weeks postoperatively and 12.5% turned had score C 12 weeks preoperatively versus no one postoperatively had C ASIA score. This agrees with **Wang *et al.*** [10] study where neurologic deficit was graded according to Frankel motor score system. 20 patients were as followed: Three patients were classified as Frankel B, 6 as Frankel C, 5 as Frankel D and 6 as Frankel E. There was no patient classified as Frankel A in this series. Neurological recovery of one to three Frankel grades was seen in 13 patients with partial neurological deficit, three grades of improvement happened in one patient (from grade B to grade E), two grades of improvement were observed in 6 patients and one grade of improvement was found in 6 patients. In only one patient with partial neurological deficit (Frankel grade D) on admission, no improvement was observed. All the neurological intact patients (6 cases) remained so during the follow-up period. Our study agrees with **Hwang *et al.*** [9]**.** The Frankel classification of neurological deficits was used, initially and at follow-up. A Frankel grade D and E was noted, respectively in 3 and 36 patients in the nonfusion group, and in 1 and 34 patients in the fusion group. All patients in both groups reached Frankel grade E at final follow-up. We also agree with a recent study done by **El Behairy *et al.*** [11] that included 32 patients with thoracolumbar fractures. Preoperative ASIA were 10 patients had

normal neurology (ASIA E), 19 had incomplete deficits (ASIA B, C, and D) and 3 had complete deficits (ASIA- A). Postoperative ASIA were: Patients with complete neurologic deficits (n = 3) did not show any neurologic recovery. Four ASIA B improved to ASIA C. Five ASIA C improved to ASIA E. The remaining 5 ASIA C patients improved to ASIA D. Five ASIA D patients improved to ASIA B.

CONCLUSION

Surgical treatment of thoracic and lumbar fractures allows for immediate stabilization of the spine, restoration of sagittal alignment and the possibility of spinal canal decompression. Regardless of the technique, pedicle screw fixation allowed for more stable constructs, earlier mobilization and better deformity correction with three column spinal fixation.

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