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Original Article

SHORT SEGMENT FIXATION FOR TREATMENT OF THORACOLUMBAR BURST FRACTURE

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Abstract

Objectives: *To evaluate the result of posterior short segment pedicle screws fixation in thoracolumbar burst fractures management.* ***Methods:*** *It is a prospective case series study of twenty a patient with a burst fracture of the thoracolumbar region was admitted to the orthopedics and traumatology department at Sohag University hospitals from January to July 2014, Short segment pedicle screw fixation was used to treat these patients.* ***Results and Conclusion:*** *This study showed that posterior short segment pedicle screw fixation is effective and sufficient for treating thoracolumbar burst fractures, improving the loss of vertebral height. At the last follow-up, the average percentage of vertebral body height loss had decreased from 36.8% before surgery to 17.6%. and with a noticeable improvement in disability scoring system and kyphotic angle.*

Keywords: *Burst fracture, Short segment, Pedicle screw fixation.*

1. Introduction

Worldwide, an estimated 5 million new spinal fractures occur each year [1]. Because of their mechanical transition zone and lack of supporting articulations with the ribs, lordotic posture, and more sagittal-oriented facet joints, the lumbar spine and thoracolumbar junction are susceptible to involvement in spinal injuries [2]. High-energy injuries that are most typically linked to falls and auto accidents can result in burst fractures [3]. *Fracture Classification includes Denis classification* [4]. Three column classification of spinal fractures. Injury to middle column is necessary and sufficient to create instability and *AO Classification* [5]. According to the mechanism of injury, it divides thoracolumbar fractures into three main types. A. Compression B. Distraction C. Multi-directional with translation**.** The AO classification is commonly used, as it provides a comprehensive classification describing the nature of injury, the degree of instability, and prognostic aspects that are important for choosing the most appropriate tr Rigid collars may be employed, and patients must first be immobilized. Before beginning the neurological examination, which involves evaluating sensation in each dermatome and grading motions for each extremity, the airway, breathing, and circulation (ABC) must be stabilized. Examining deep tendon reflexes is also necessary. The anal sphincteric tone and perianal senses can be evaluated with a rectal examination radiological assessment [6]. 1 anteroposterior (AP) and lateral plain radiograph of the potentially affected

segment. 2. computed tomography (CT) offers more diagnostic information than standard radiography. The CT scan's improved capacity to determine the extent of canal damage is another benefit. MRI is useful in identifying the posterior ligamentous complex and is occasionally performed in cases of neurological affection to detect cord lesions or compression. *Non-operative Management***:** Since the majority of thoracolumbar fractures either compression or burst fractures are stable, non-operative treatment may be useful**.** *Operative Management*: Stabilization, neural decompression, and fusion are the three fundamental surgical procedures used to treat thoracolumbar and lumbar burst fractures [7]. *Stabilization*: Correcting acute abnormalities and restoring immediate stability are the main functions of surgical instruments. Because pedicle screws provide biomechanical advantages, especially in the thoracolumbar and lumbar areas, they have largely replaced hooks and wires for posterior stabilization. Additionally, pedicle screws offer three-column fixation. Pedicle screws also have the benefit of restoring stability with fewer anchoring points, saving motion segments. For extremely unstable fractures, we frequently instrument two levels above and below the damaged segment in our practice. However, only one level above and below can be used to address cases with less severe instability. *Neural decompression*: In order to decompress the neuronal components, surgery is typically regarded as the first line of treatment for patients with neurological deficits. *FUSION*: In order to keep the equipment from failing, solid fusion must be accomplished. Aim of the work: To evaluate the result of posterior short segment pedicle screws fixation in treatment of burst fractures of thoracolumbar spine (type A3 according to AO classification).

2. Patients and Methods

It is a prospective case series study of twenty patients from January to July 2014, a patient with a burst fracture of the thoracolumbar region was admitted to the orthopedics and traumatology department at Sohag University hospitals. An informed written consent was obtained from all participants. The study and follow up was approved by Scientific and Ethical committees at Sohag faculty of medicine.

2.1. *Types of participants*

Skeletally mature patients with burst fracture at thoracolumbar area (Th 11-L2) type A3 according to Ao/Magerl classification either neurologically free or neurologically compromised patients. Skeletally immature patients and other types of fracture vertebrae or fractures at other levels were excluded from this study. Patients in our study were treated by short segments pedicle screw fixation. In cases suffering from neurological affection, the neural canal was decompressed and posterolateral fusion was done.

2.2. *Method of operation for pedicle screw fixation*

2.2.1. Anesthesia

General anesthesia was used in these cases.

2.2.2. Patient positioning

In order to reduce operative bleeding and to extend the spine in order to open up the affected segment anteriorly for indirect reduction using the principle of ligamentotaxis, the patient was placed in a prone position on a radiolucent spine table over the spinal frame supporting the chest and pelvis. This allowed the anterior abdominal wall to clear the table and allow the non-valvular vertebral venous plexus to empty into the vena cava. All patients received one gram. first-generation cephalosporines half an hour prior to surgery. Catheterization was performed on all patients who were admitted with urine retention. Throughout the process, fluoroscopy was employed.

2.2.3. Incision

a straight midline incision was made one level above and one level below the fractured segment.

2.2.4. Superficial and deep surgical dissection

Move the muscle origins to either side of the surface using a Cobb elevator, and

palpate each individual spinous process as it continues to dissect down to the midline. By subperiosteal dissection, the paraspinal muscles are separated from the spinous processes and partially from the laminae. Self-retaining retractors are then used to maintain the dissection open, fig. (1). The short rotators are still being removed from the base of spinous processes to the leading edge of the laminae utilizing a Cobb elevator. After that, remove the muscles from the remaining laminae till the transverse processes are reached.

Figure (1) Surgical dissection

2.3. *Insertion of pedicle screws*

2.3.1. In lumbar vertebrae

The transverse processes on either side of the vertebrae are distinguished by their superior and inferior borders. The junction of a line that cuts the transverse process and the lateral margin of the facet joint complex is regarded as the point of

2.3.2. In thoracic vertebrae.

The meeting of the upper border of the rib and the lateral margin of the facet joint complex is entry point to the pedicles. After roughening this area with a little bone nibbler, we begin the tract in the pedicle with an Awl and ensure appropriate passage within the pedicle's borders with a pedicle probe. After that tapping the resulting tract and inserting a screw with the proper length and diameter, fig. (2). The connecting rods are positioned following the pedicle screws' insertion. In order to minimize the vertebral fracture by ligamentotaxis and restore vertebral height we do distraction, fig. (3). In cases of neurological affection, the neural canal is decompressed by performing a laminectomy, retracting the cord, and pushing any displaced fragments from inside the canal forward. When decompression is performed, vertebral fusion is accomplished either postrolaterally with autogenous bone grafting or posteriorly by decorticating exposed bone elements in patients who are neurologically intact.

Figure (2). Insertion of screws

Figure (3) Fracture reduction by ligamentotaxis

2.4. *Closure*

Following the fixation, lavage is administered with regular saline. Layers of the incision closed. The wounds are covered with sterile dressings.

2.5. *Follow up*

At two weeks, four weeks, two months, four months, and six months, all patients were checked in to have their sutures taken out. Vertebral fusion, vertebral height loss, and metal failure in the form of rod migration or screw backing out were assessed for each visit using AP and lateral views of x-rays. A neurological and clinical assessment was assessed. In the last follow up Cobb angle was measured and Modified Oswestry Low Back Pain Disability score method was assessed.

Case 1: 26 years old, male patient, MCA, Burst fracture D12, Neuro free, T P F, only Modified Oswestry Low Back Pain Disability Score = 14%, fig. (4).

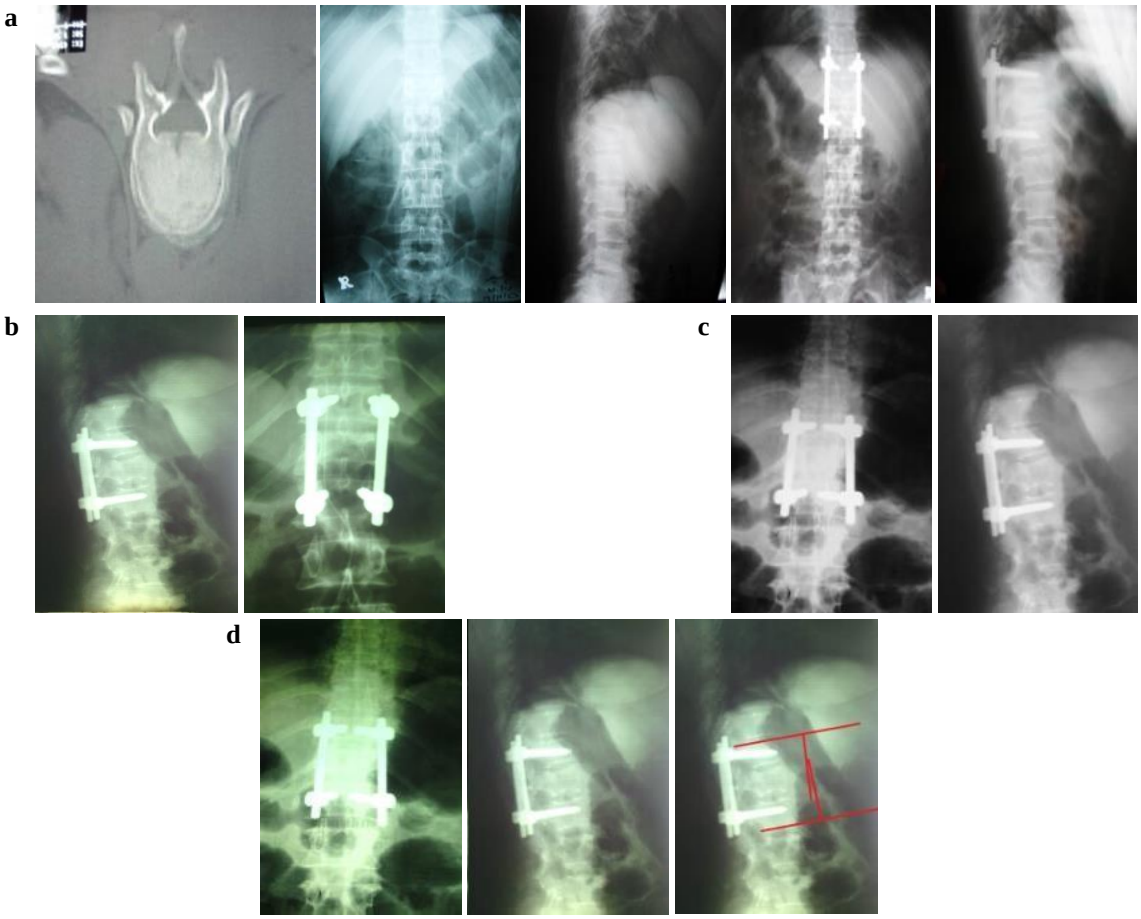

Figure (4) **a.** Post-operative X-ray, **b.** after two months, **c.** after four months, **d.** After six months

3. Results

Distribution of cases by age and sex, tab. (1). 15 patients in our series, were in the 20-40 age representing about (75%) of the patient. The mean age was thirty-one ranging from (17 -55) years. Only five of the patients were female, with the majority (15) being male, fig. (5). Mode of trauma, tab. (2). Level of fractured vertebra, tab. (3) Only one case in our analysis had a two-level burst fracture; all other cases had injuries to just one level, tab. (3) shows that around 40% of the cases were at L1, 30% at L2, and 25% at Th 12. Neurological affection, tab. (4) The most of patients were neurologically free before to surgery (13 patients), while seven patients had neurological effects. Four of these patients recovered after surgery, and three instances remained unchanged, tab. (4). Type of operation, tab. (5) Most of patients (13/20), or roughly 65%, underwent surgery using posterior pedicle screw fixation without decompression. In the remaining cases (7/20), decompression was required due to neurological injury. Loss of vertebral height in percentage, tab. (6) Vertebral height loss significantly improved in the current study series. At the last follow-up, the average percentage of vertebral body height loss had decreased from 36.8% before surgery to 17.6%.

Table (1) Distribution of cases by age and sex.

Age group	No. of Patients	Cumulative percent %
Less than 20 years	1	5
20-30 years	10	50
30-40years	4	25
40-60 yers	5	20
Total	20	100

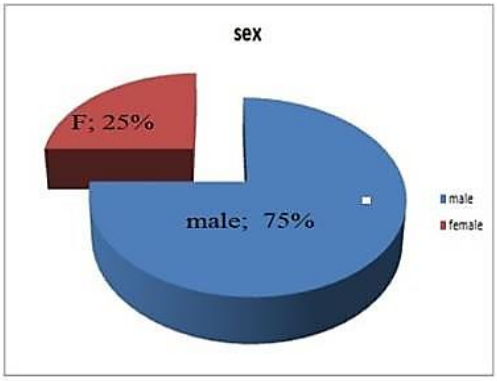

Figure (5) Chart represents sex distribution of cases

Table (2) Mode of trauma

	No. of Patients	Cumulative percent %
Falling from height	13	65
Motor car accident	6	30
Direct trauma	1	5
Total	20	100

Table (3) Level of fractured vertebra

Level	Sex		Total
	No. males	*No. females*	
Th 12	4	1	5
L 1	6	2	8
L 2	4	2	6
Th12 & L1	1	0	1
Total	15	5	0

Table (4) Neurological affection (*Neurology of the patients*)

	No. of patients preoperatively	No. of patients 6 months postoperatively
Frankle E	13	16
Frankle D	3	2
Frankle C	2	0
Frankle B	1	1
Frankle A	1	1
Total	20	20

Table (5) Type of operation

	Patients number	Percent %
Fixation only	13	65
Fixation and decompression with posterolateral fusion	7	35
Total	20	100

Table (6) Loss of vertebral height in percentage

	No. of patients preoperatively	No. of patients 6 months postoperatively
> 10 %	0	6
10-20 %	1	9
20-30 %	5	2
30-40 %	7	1
More than 40 %	7	2
Total	20	20

3.1. *Modified Oswestry low back pain disability scoring system*

Ten cases (about 50%) in our study series, fig. (6) had minimal disability, meaning they could manage most activities of daily living; six cases (30%) had moderate disability, with the back condition typically being treated conservatively; and three cases (15%) had severe disability, requiring strong analgesics and there was just one example that was crippled.

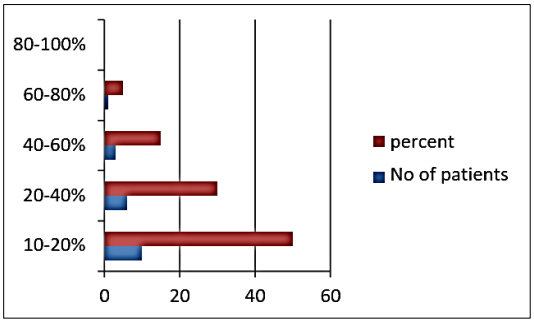

Figure (6) Chart represents results of disability scoring system.

3.2. *Intra operative and postoperative complications*

Two patients in our study experienced dural tears, fig. (7). They were given powerful antibiotics, slept in a prone posture in bed, and recovered subsequently. Metal failure in two instances manifested as backing out of the rods and knot migration. One patient had a pylon fracture, which resulted in a deep infection in his leg. Debridement and implant removal were performed.

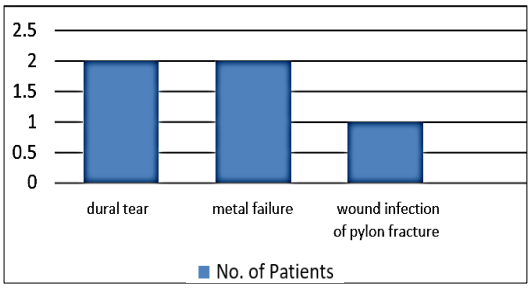

Figure (7) dural tears

3.3. *Angle of kyphosis (cobb angle)*

The Cobb method depicts the superior endplate of the higher adjacent vertebra and the inferior endplate of the lower adjacent vertebrae as the angle formed by two lines drawn perpendicular to each other. Both before surgery and at the most recent visit, it was measured. Preoperative mean kyphotic angle was 19.5o, and postoperative mean kyphotic angle was 10.15o. Kyphotic angle improved in our study. The majority of the cases (17/20) were minimum to mild, with only one case being severe during the most recent visit. Angle of kyphosis, tab. (7).

Table (7) Angle of kyphosis

	No. of patients preoperatively	No. of patients 6 months postoperatively
Minimal (0-5)	0	9
Mild (6-15)	6	8
Moderate (16-25)	10	2
Sever (>25)	4	1
Total	20	20

4. Discussion

As the thoracolumbar junction is the transitional area between a more mobile lumbar lordosis and a rather inflexible thoracic kyphosis, burst fractures are frequently observed there. The lowest thoracic ribs are free-floating and do not attach to the sternum. Additionally, the coronal (frontal) plane is where the thoracic region's facet joints are oriented. It is widely accepted that thoracolumbar burst fractures should be addressed surgically [8]. Regardless of the approach taken, the objectives of treating thoracolumbar fractures are to restore the stability of the vertebral column and, if neurologically impacted, to decompress the spinal canal, allowing the patient to be mobilized earlier [9,10]. The management of thoracolumbar burst fractures is still debatable, nevertheless. One common choice is short-segment pedicle fixation [11]. This study attempted to assess the use of short segment pedicle screw fixation in the treatment of burst fractures at the thoracolumbar junction. From January to July 2014, 20 patients who were admitted to the orthopedics and traumatology department of Sohag University hospitals participated in the study.

4.1. *Age distribution*

Men are more likely than women to sustain a thoracolumbar fracture, which often occurs between the ages of 20 and 40 [12-14]. Males were more prevalent in our study. The majority of them were in their third or fourth decade of life, and the male to female ratio was 3:1. Because

they are more gregarious, interested in occupations like farming and driving, and more likely to be involved in or prone to accidents or falls, men made up the bulk of the patients in this series. Women are more involved in household chores and play a more passive role. The average age was thirty-one years, which is consistent with the average age of patients reported in other research.

4.2. *Mode of injury*

The most frequent causes are motor vehicle accidents and falls from a height. Thirty percent of the cases in our study had burst fractures from motor vehicle accidents, and sixty-five percent had them from falls from heights.

4.3. *Level of fractured vertebra*

About 40% of our cases had a burst fracture at L1, 30% at L2, and 25% at Th12. The majority of our cases had single level injuries. In a study of 1446 thoracolumbar fractures, Magerl and Engelhardt [15] found that the first lumbar vertebra was most commonly injured (28%), followed by the T12 (17%) and L2 (14%). The German Trauma Society's epidemiologic multicenter study on thoracolumbar transition (T10–L2) fractures examined 682 patients and found that 50% of them had L1 fractures, 25% had T12 fractures, and 21% had L2 fractures [13,14].

4.4. *Neurology of the patients*

Ten to thirty percent of severe spinal fractures result in spinal cord damage. About 35% of the participants in our study series experienced neurological affection. Gertzbein and Magerl et al. reported neurological deficits of 35.8% and 22%, respectively. According to the German Society of Traumatology's epidemiologic multicenter study on thoracolumbar transition (T10-L2) fractures [17, 18] 22% of patients had neurological deficits.

4.5. *Metal failure*

In our study, two cases had metal failure in the form of knot migration and backing out of the rods. Both cases were Frankle B & D and decompression was needed. Metal failure occurs in the 2nd month postoperatively and removal of the implant was done in one case only. Early failure of short-segment pedicle instrumentation for thoracolumbar fractures was shown by McLain et al. [19]. Ten patients out of 19 with unstable thoracolumbar fractures experienced early fixation failure, which included vertebral translation, increasing kyphosis, osseous collapse, and screw breakage or loosening.

4.6. *Angle of kyphosis*

In our study, there was improvement in kyphotic angle. Mean kyphotic angle pre-operative was= 19.5^0 and post-operative mean angle =10.15^0 George Sapkas et al. [20] out of 40 patients with unstable thoracolumbar fractures, 20 patients treated by short segment fixation and the others treated by long segment screws fixation no statistically significant difference was noted between the short segment and long segment instrumentation group. These results suggest that LS and SS stabilization are equivalently able in reducing the segmental kyphosis and the vertebral body deformation

4.7. *Disability scoring system*

Ten instances (about fifty percent) had minimal disability, meaning they could manage most daily tasks; six cases (30 percent) had moderate disability, with the back problem typically being treated conservatively; and three cases (15 percent) had severe disability, requiring strong analgesics and there was just one example that was crippled. According to George Sapkas et al. [20], long segment stability was linked to superior outcomes in terms of patient satisfaction at the long-term follow-up. About 80% of patients treated with lengthy segments had minimal disabilities, but only about 45% of patients treated with short segments had minimum disabilities. According to some research, individuals who received short segment pedicle instrumentation have positive clinical long-term outcomes [21,22].

5. Conclusion

When a patient's neurological status remains unharmed, posterior short segment pedicle screw fixation is an effective and sufficient treatment for thoracolumbar spine burst fractures. However, long segment fixation is preferable if the patient's

neurological status is compromised and spinal canal decompression is required in order to establish excellent stability and avoid metal failure, increasing kyphosis, and vertebral collapse.

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