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Short segment versus long segment pedicle screws fixation in management of thoracolumbar burst fractures

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Abstract---Background: Selection of stabilization procedures for treating thoracolumbar burst fractures remains controversial. Both long-segment and short-segment pedicle screw fixation have been used widely with no consensus on the better method. Aim of study: To compare the outcome of long segment and short segment posterior fixation as amanagement of thoracolumbar burst fractures. Patients and Methods: 60 patients fulfilling the inclusion criteria who underwent posterior pedicle screw fixation for burst fracture of thoracolumbar spine in Neurosurgery Department of Al-Azhar University Hospitals and El-Ahrar General Hospital, Zagazig between August 2019 and Febrauray 2022. Patients were randomized into one of two groups. Short segment group (30 patients) was treated by short segment fixation, i.e., 1 level above and 1 level below the fractured vertebra. Long segment group (30 patients) was treated by long segment pedicle screw fixation, i.e., fixation of 2 levels above and below the fractured vertebra. Assessment of kyphosis correction by using the Cobb method and restoration of the anterior vertebral body height was performed radiologically postoperatively and at 3 and 6 months follow up. Results: Demographic data of both groups were quite comparable. The mean operative time in short segment group (187.25±20.25 min) was significantly shorter than long segment fixation group (212.22±30.51 min). Blood loss was significantly less in short segment group (567±87.8 ml) than long segment fixation group (870.3±107.8 ml). Follow up cobb's angle (12 week after surgery) was

significantly lower in long segment fixation group than short segment fixation group (7.7±2.03 vs 9.03±1.67, p=0.007), Absolute decrease of angle of kyphosis in long segment fixation group was significantly higher in long segment fixation group than short segment group (16.55±4.80 vs 13.22±2.35, p=0.001). Conclusion: Short-segment fixation is as effective as long-segment pedicle screw fixation for treating thoracolumbar burst fractures. It preserves motion segments and reduces the costs of surgery and seems to result in a better clinical outcome.

Keywords---thoracolumbar burst fracture, long-segment, pedicle screw fixation, short-segment.

Introduction

Thoracolumbar (TL) fractures are the most common traumatic injuries to the spinal column. The annual incidence of TL injures in the United States is approximately 15,000; the majority of those incidents are due to high-energy trauma resulting mainly from a motor vehicle accident in younger patients. Also, nearly 700,000 osteoporotic fractures occur annually in elderly patients [1]. Most commonly, TL injuries occur at the T10 to L2 level. The TL junction is more susceptible to injury because there is a transition between the stiff kyphotic thoracic spine and the mobile lordotic lumbar spine. Approximately 25% percent of TL fractures result in neurological deficit. The four major spinal injuries are compression fractures, burst fractures, flexion-distraction injuries, and translational injuries [2].

Denis et al 1983 defined the burst fracture in his 3-column theory as a compression fracture of the anterior and middle vertebral columns, which causes retropulsion of a posterior vertebral body fragment into the spinal canal [3]. It is the most common spinal fractures have been reported to be in the thoracolumbar region because it is in the transition zone between the rigid thoracic kyphosis and more flexible lumbar lordosis [4]. Conservative treatment is usually the method of choice if there is little kyphotic deformity, no neurological deficit or no unstable posterior vertebral column. In unstable thoracolumbar burst fractures, operative stabilization is preferred. The main goals of surgery are restoration of spinal stability, correction of deformity, and decompression of the spinal canal with the preservation of neurologic function [5, 6].

An anterior or posterior approach, or combined approaches are used for the treatment of thoracolumbar burst fractures [7]. However, there is no consensus regarding the best surgical approach. Nevertheless, spine surgeons often prefer the posterior approach because of its easy application, reduction of intraoperative bleeding and low degree of invasiveness [8]. It has become the most used method in the surgical treatment of thoracolumbar burst fractures with advantages such as more safety in exploring the surgical site without violating the pulmonary, visceral, and vascular structures, being less technically demanding and familiar to a spine surgeon [9]. Long-Segment Posterior Fixation (LSPF) at least two levels above and below the fractured vertebra [10]. Allows for a stronger construct,

though limits flexibility at the fractured level and is more extensile and may be associated with higher intraoperative blood loss and length of operation. Short segment fixation has largely replaced long-fixation in the management of burst fractures. However, instrument failure and recurrence of kyphosis are reported if short-segment posterior fixation. The implant failure in Short-Segment Posterior Fixation (SSPF) can be circumvented by using an indexing screw in the fractured vertebra or by augmenting posterior fixation with anterior column reconstruction. Several study attempts to compare SSPF with LSPF though each has significant limitations [3, 5, and 11]. The aim of this study was to compare the outcome of long segment and short segment posterior fixation as amanagement of thoracolumbar burst fractures.

Patients and Methods

In this prospective comparative study, 60 patients fulfilling the inclusion criteria who underwent posterior pedicle screw fixation for burst fracture of thoracolumbar spine in Neurosurgery Department of Al-Azhar University Hospitals and El-Ahrar General Hospital, Zagazig between August 2019 and Febrauray 2022.

Patients were randomized into one of two groups

Short segment group (30 patients) was treated by short segment fixation, i.e., 1 level above and 1 level below the fractured vertebra. Long segment group (30 patients) was treated by long segment pedicle screw fixation, i.e., fixation of 2 levels above and below the fractured vertebra.

Inclusion criteria

Aged 18 - 55 years, agreed to be study subjects, patients with traumatic thoracolumbar burst fractures indicated to surgical intervention by short or long segment pedicle screw fixation, patients with normal spinal conditions before the fracture occurred.

Exclusion criteria

Patients presented by non traumatic thoracolumbar fractures, patients with more than one-level fracture, patients with compromised spinal canal more than 50%, patients with marked kyphosis or scoliosis.

Ethical approval

The study had approval by the Institutional Review Board (IRB) Committee of Al-Azhar University Hospitals. At the time of enrollment, a written informed consent was obtained from the participants sharing in the study.

Methodology

Pre-operative Evaluation

History taking: full history taking including age and sex, general examination, local clinical evaluation: Type of trauma, full Neurological Examination by American Spinal Injury Association (ASIA) scale, level of fracture, and pain visual analogue score (VAS) and radiological Evaluation: X-ray, CT, and MRI of thoracolumbar area.

Operative procedures

Patients were carefully log rolled into a hyperextended, prone position with the abdomen hanging free of the purpose of minimizing bleeding from the epidural venous plexus and achieving a significant initial reduction of the spinal fracture. Under all aseptic precautions, partly prepared and draped. The incision is given from one or two spinous processes above and below the area to be instrumented. Fascia and the par spinal muscles elevated from lamina up to the tips of the transverse processes. Pedicle screws were inserted one level above and below the fractured vertebra for Short-Segment Posterior Fixation (SSPF) (Short-Segment Group) and two or more than two levels above and below for Long-Segment Posterior Fixation (LSPF) (Long-Segment Group) and fixed with the rod on one side provisionally followed by Posterior or Poster lateral decompression and the anterior column was reconstructed using either cage filled with graft or graft alone. After pedicle screw instrumentation, the 6 mm rods were contoured to reproduce the normal sagittal curvature of the thoracolumbar spine. The rods were then fixed within the heads of the pedicle screws, and torque was applied through the rod pusher to bring the vertebra back to the rod.

Reduction of the fracture was accomplished by applying a gentle distraction force at the level of the fracture (ligamentotaxis). Decompression by total or partial posterior laminectomy was performed only in cases where the spinal canal was narrowed by more than 50% by free bone fragments. This was followed by pushing back those bone fragments into their original positions. A cross connector was used to link the rods.. All patients were required to wear a rigid thoracolumbar orthosis (TLSO) for a minimum of 3 months postoperatively when they were able to stand upright. We manipulated the rods to gain distraction and derotation along with hyperextension of the injured level which led to the correction of deformity and indirect decompression of spinal canal at the level of fracture and stenosis. Early postoperative mobilization of patients started the next day and consisted of turning to sides and performing active exercises for body and extremities .In cases with neurological deficit it consisted of turning side to side ,gradual verticalization ,breathing exercises and positioning of the legs in order to prevent flexion contracture of the joints.

Post operative Evaluation

- Clinical and radiological evaluation.
- Pain evaluation by VAS score.
- Oswestry Disability Index (ODI) score.

Post operative compplications

- Wound infection
- CSF leakage.
- New neurological deficit.
- Vascular complications.

Follow-up imaging evaluation

- Implant system failure.
- Caps loosening.
- Rod slippage.
- Screw breakage.
- Screw pullout.
- Cross-link slippage.

Statistical analysis

Statistical analysis was done using Data were analyzed using IBM© SPSS© Statistics version 26 (IBM© Corp., Armonk, NY) and MedCalc® Statistical Software version 20 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2021). Categorical variables are presented as counts and percentages or ratio and intergroup differences are compared using the Pearson chi-square test or Fisher's exact test. Continuous numerical variables are presented as mean and standard deviation and intergroup differences are compared with the independent-samples t-test. Discrete numerical variables are presented as median and range and differences are compared with the Mann-Whitney test. P-values <0.05 are considered statistically significant.

Results

Male was the predominant sex in both short and long segment fixation groups. Mean age in short segment fixation group was 30.75 years (22-40 years) while in long segment fixation group mean age was 29.25 (18-45 years) with no significant differences between them (Table 1).

Table 1
Demographic data of studied groups

Demographic data	Short segment fixation (SS) (N=30)		Long segment fixation (LS) (N=30)		Test	P-value (Sig.)
Sex Male Female	 17 13	 57% 43%	 19 11	 63% 37%	0.069	0.792 (NS)
Age (years) Mean ± SD (Range)	 30.75 ± 5.95 (22-40)		 29.25±8.65 (18-45)		0.783	0.437 (NS)

The most prevalent pain visual analogue score (PVAS) in both groups was mild score where it constituted 60% of short segment fixation group versus 70 % of long segment fixation group (Mean ±SD: 6.21±1.5 vs 5.66±1.23) of insignificant difference between two studied groups (p>0.05) (Table 2).

Table 2
Comparison between short segment fixation group and long segment fixation group as regard preoperative clinical evaluation

Pre-operative PVAS	Short segment fixation (SS) (N=30)		Long segment fixation (LS) (N=30)		Test	P-value (Sig.)
PVAS						
No pain	0	0%	0	0%		
Mild	18	60%	21	70%	0.293	0.588
Moderate	12	40%	9	30%		(NS)
Severe	0	0%	0	0%		
Mean ± SD	6.21±1.5		5.66 ±1.23			0.125
Median (range)	15 (4-9)		5.5 (4-8)		1.553	(NS)

The operative time in short segment group (187.25±20.25 min) was significantly shorter than long segment fixation group (212.22±30.51 min). Blood loss was significantly less in short segment group (567±87.8 ml) than long segment fixation group (870.3±107.8 ml) (Table 3).

Table 3
Operative time and blood loss of studied cases

Early postoperative Clinical evaluation	Short segment fixation (SS) (N=30)	Long segment fixation (LS) (N=30)	Test	P-value (Sig.)
Operative time (minutes)				
Mean ± SD	187.25±20.25	212.22±30.51	3.735	0.0004
(Range)	(150-230)	(180-270)		(HS)
Blood loss (ml)				
Mean ± SD	567±87.8	870.3±107.8	11.949	<0.0001
(Range)	(490-700)	(600-920)		(HS)

Early postoperative clinical evaluation (0-3 days after surgery, during hospital stay): PVAS was insignificantly lower in short segment than long segment fixation group (Mean±SD: 4.16±1.61 vs 4.91±1.62, p=0.077), 57% of short segment fixation group had mild VAS of pain compared 57% of long segment fixation group had moderate VAS of pain (Table 10, figure 28). Also ODI was insignificantly lower in short segment fixation compared to long segment fixation group (Mean±SD: 28.44±12.58 vs 33.83±11.58). 50% of short segment fixation group had minimal ODI compared to 50% of long segment fixation group had moderate ODI (Table 4).

Table 4
Early postoperative clinical evaluation

Early postoperative Clinical evaluation	Short segment fixation (SS) (N=30)	Long segment fixation (LS) (N=30)	Test	P-value (Sig.)
PVAS				
No pain	0 0%	0 0%		
Mild	17 57%	8 27%	5.555	0.062
Moderate	10 33%	17 57%		(NS)
Severe	3 10%	5 16%		
Mean ± SD (Range)	4.16 ± 1.61 (2-7)	4.91± 1.62 (3-8)	1.799	0 .077 (NS)
ODI				
Minimal	15 50%	7 23%		
Moderate	11 37%	15 50%	4.858	0.088
Severe	4 13%	8 27%		(NS)
Very serious	0 0%	0 0%		
Exaggerated	0 0%	0 0%		
Mean ± SD (Range)	28.44±12.58 (10-44)	33.83±11.58 (10-48)	1.727	0.089 (NS)

There was significant shorter hospital stays in short segment (7.52±2.85 days) compared to segment fixation group (9.22±3.25 days) (p=0.035). CSF leakage occurs in only one patient of short segment fixation group (3.3%) versus two patients of long segment fixation group (6.7%), also new neurological deficit occurs in only two patients of short segment fixation group (6.7%) versus three patients of long segment fixation group (10%) of insignificant difference between two studied groups (p=0.571) (Table 5). No mortality rate recorded among studied cases.

Table 5
Primary outcome in studied groups

Primary outcome	Short segment fixation (SS) (N=30)	Long segment fixation (LS) (N=30)	Test	P-value (Sig.)
Hospital stays (days)				
Mean ± SD (Range)	7.52±2.85 (6-10)	9.22±3.25 (7-14)	2.154	0.035 (S)
Early Postop. complications				
Wound infection	0 0%	0 0%		
CSF leakage	1 3.3%	2 6.7%	0.320	0.571
New Neurological deficit	2 6.7%	3 10%		
Vascular complications	0 0%	0 0%		
Mortality rate	0 0%	0 0%		

Late postoperative clinical evaluation (after 12 weeks follow up): 67% of short segment had minimal ODI compared to 57% of long segment fixation group. 23% and 10% of short and long segment fixation groups respectively had no pain while 10% and 33% of short and long segment fixation groups respectively had moderate VAS for pain. Mean±SD of PVAS was 3.85 ± 1.88 vs 4.41±1.78 with insignificant differences between them (p=0.241). 60% and 67% of short and long segment fixation groups respectively had moderate ODI while 40% and 33% of short and long segment fixation groups respectively had minimal ODI. Mean±SD of ODI was 22.62 ± 8.46 vs 24.33 ± 9.99 in short and long segment fixation groups respectively with insignificant differences between them (p=0.477) (Table 6).

Table 6
Late postoperative clinical evaluation

Follow up of Clinical evaluation (12 week post-op)	Short segment fixation (SS) (N=30)	Long segment fixation (LS) (N=30)	Test	P-value (Sig.)
PVAS				
No pain	7 23%	3 10%		
Mild	20 67%	17 57%	5.612	0.0604
Moderate	3 10%	10 33%		(NS)
Severe	0 0%	0 0%		
Mean ± SD	3.85 ± 1.88	4.41±1.78	1.185	0.241
(range)	(0-6)	(2-8)		(NS)
ODI				
Minimal	12 40%	10 33%		
Moderate	18 60%	20 67%		
Severe	0 0%	0 0%	0.072	0.788
Very serious	0 0%	0 0%		(NS)
Exaggerated	0 0%	0 0%		
Mean ± SD	22.62 ± 8.46	24.33 ± 9.99	0.715	0.477
(Range)	(10-34)	(10-38)		(NS)

Follow-up imaging evaluation (12 week after surgery): 12 week after surgery, 7 cases of short segment group presented with implant failure (5 cases with screw breakage and 2 cases with rod breakage) versus to 3 cases of long segment group presented with rod breakage with insignificant differences between them (p=0.167) (Table 7).

Table 7
Comparison between short segment fixation group and long segment fixation

Follow up Imaging evaluation (12 week Post-op)	Short segment fixation (SS) (N=30)	Long segment fixation (LS) (N=30)	Test	P-value (Sig.)
Implant system failure				
Caps loosening	0 0%	0 0%		

Rod slippage	0 0%	0 0%		
Screw breakage	5 17%	0 0%	1.908	0.167
Screw pullout	0 0%	0 0%		(NS)
Rod breakage	2 6%	3 10%		
Cross-link slippage	0 0%	0 0%		

Change in VAS of pain: There were insignificant improvements in PVAS in both groups. 7 cases (23%) and 3 cases (10%) of short and long segment group was improved from mild PVAS to no pain. 7 cases (23%) in both groups were improved from moderate to mild PVAS. 2 cases (6%) in both groups were improved from severe to mild PVAS. 3 cases (10%) of long segment group was improved from severe to moderate PVAS compared to no cases in short segment group (p=0.246) (Table 8).

Table 8
Comparison between short segment fixation group and long segment fixation group as regard change in VAS of pain

Change in PVAS	Short segment fixation (SS) (N=30)	Long segment fixation (LS) (N=30)	Test ‡	P-value (Sig.)
Change				
Mild to no pain	7 23%	3 10%		
Mild (no change)	11 37%	8 27%		
Moderate to no pain	0 0%	0 0%		
Moderate to mild	7 23%	7 23%		
Moderate (no change)	3 10%	7 23%	6.674	0.246
Moderate to severe	0 0%	0 0%		(NS)
Severe to no pain	0 0%	0 0%		
Severe to mild	2 6%	2 6%		
Severe to moderate	0 0%	3 10%		
Severe (No change)	0 0%	0 0%		

There was significant difference between both groups regards absolute reduction of VAS of pain (Mean±SD: 1.41±0.33 vs 0.50±0.16, p<0.01) and also relative reduction % of VAS in short segment fixation group was significantly higher than long segment fixation group (Mean±SD: 38.52 ± 20.49 % vs 10.18 ± 9.87%, p<0.01) (Table 9).

Table 9
Comparison between short and long segment fixation groups as regard change in VAS of pain within mean difference and reduction

Change in PVAS	Short segment fixation (SS) (N=30)	Long segment fixation (LS) (N=30)	Test	P-value (Sig.)
Post-op PVAS (0-3 days post op) Mean± SD	4.16 ± 1.61	4.91±1.62	1.799	0.077

(range)	(2-7)	(3-8)		(NS)
Follow -up PVAS (12 week post op) Mean± SD (range)	3.85 ± 1.88 (0-6)	4.41±1.78 (2-8)	1.185	0.241 (NS)
Test‡ of mean difference p-value (Sig.) Absolute reduction relative reduction %	0.686‡ 0.495 (NS) 1.41± 0.33 38.52± 20.49	1.138‡ 0.259 (NS) 0.50±0.16 10.18±9.87	13.591 6.825	<0.001(HS) <0.001(HS)

Mann Whitney U test. ‡ Wilcoxon signed ranks test of mean difference.
p< 0.05 is significant. Sig.: Significance.

Change in ODI: There was high statistical significant difference between both groups as regard absolute reduction of ODI (Mean±SD: 5.82±4.12 vs 9.50±1.59, p<0.001), also relative reduction of ODI % was insignificantly lower in short segment than long segment fixation group (Mean±SD: 20.45±32.75 % vs 28.08±13.73%, p=0.244) (Table 10).

Table 10
Comparison between short segment fixation group and long segment fixation group as regard change in ODI within mean difference and reduction

Change in ODI	Short segment fixation (SS) (N=30)	Long segment fixation (LS) (N=30)	Test	P-value (Sig.)
Post-op ODI (0-3 days post op) Mean ± SD Median (range)	28.44±12.58 (10-44)	33.83±11.58 (10-48)	1.727	0.089 (NS)
Follow -up ODI (12 week post op) Mean± SD Median (range)	22.62 ± 8.46 (10-34)	24.33 ± 9.99 (10-38)	0.715	0.477 (NS)
Test‡ of mean difference p-value (Sig.) Absolute reduction Relative reduction %	-2.103 ‡ 0.039 (S) 5.82±4.12 20.45±32.75	-3.402‡ 0.001 (HS) 9.50±1.59 28.08±13.73	4.564 1.177	<0.0001 0.244

Mann Whitney U test.‡ Wilcoxon signed ranks test.
p< 0.05 is significant. Sig.: Significance.

Discussion

In current study, 60 patients fulfilling the inclusion criteria who underwent posterior pedicle screw fixation for burst fracture of thoracolumbar spine. According to pedicle screw used; enrolled patients were divided into equal two groups: Short-Segment Group where pedicle screws were inserted one level above and below the fractured vertebra for Short-Segment Posterior Fixation (SSPF) and Long-Segment Group where two or more than two levels above and below for Long-Segment Posterior Fixation (LSPF) and fixed with the rod on one side

provisionally followed by Posterior or Poster lateral decompression and the anterior column was reconstructed using either cage filled with graft or graft alone.

Our study revealed male predominance both short and long segment fixation groups. Mean age in short segment fixation group was 30.75 years (22-40 years) while in long segment fixation group mean age was 29.25 (18-45 years) with no significant differences between them. In agreement with current study, Biakto et al. [12] study, found that the age of the subjects enrolled in their study ranged from 18 to 55 years, with an average age of 35 ± 13 years. The majority of the subjects are men (71.4%) compared to women (28.6%). Also Ye et al. [13] found the age range of the patients in group 1 was 16–63 (average: 39.6) years, and the male: female ratio was 15:9. The age range in group 2 was 14–60 (average: 38.7) years, and the male: female ratio was 13: 7.

Regards to type of trauma, fall from height was the predominant type in long segment fixation group (40%) while MBA was the predominant type of trauma in short segment fixation group occurred in short segment group (43%). Similar to current findings, El-Sharkawi et al. [14] revealed the mechanism of injury was falling from a height in 26 patients (52%), motor vehicle accidents (MVA) in 16 patients (32%), falling downstairs (FDS) in 5 patients (10%), and falling of a heavy object on the back in 2 patients (FHO) (4%). Salama et al. [15] in their study, 11 patients were subjected to RTA and nine patients to falling from a height in the short-segment group; in the long-segment group, 13 patients were subjected to RTA and seven patients to falling from a height. In current study, the most prevalent level of fracture in both groups at L1 where it constitutes 50% and 57% of short versus long segment fixation groups respectively with no statistical significant differences between them (P>0.05).

This is in accordance with research conducted by Hur et al. [16] in 2015, The highest incidence of burst fractures occurred mainly in L1 (71.4%) compared to the T12 (19.0%), and L2 (9.5%) due to the shift from less mobile to more mobile areas. Regards to neurological status, patients that are neurologically intact (ASIA E) constitute 67% of short segment fixation group versus 50% of long segment fixation group with no significant differences between them. In Biakto et al. [12] study, more patients with normal neurological status in short type fixation group (20%) compared to the long type fixation group (18.8%). Patients who underwent short fixation experienced fewer incomplete neurological disabilities (40%) than long segment (50%). The difference in ASIA impairment scale between the two types of fixation did not differ significantly (p > 0.05).

Early postoperative clinical evaluation (0-3 days after surgery, during hospital stay): PVAS was insignificantly lower in short segment than long segment fixation group (Mean±SD: 4.16±1.61 vs 4.91±1.62, p=0.077), 57% of short segment fixation group had mild VAS of pain compared 57% of long segment fixation group had moderate VAS of pain. In line with Necdet et al. [17] that there are no significant between the short and the long segment pedicle screw fixation in early postoperative VAS score assessment. Against current study Biakto et al. [12] in their study revealed patient satisfaction rates, assessed by VAS, were more severe in patients treated with long segment fixation (75%) than short segment fixation

(20%). There was a significant difference (p = 0.047) in the moderate category (VAS 3-7).

In Ye et al. [13] study, preoperative VAS scores were 7.7±0.5 and 7.9±0.5 points in group 1 and group 2, respectively, and the scores were significantly reduced in both groups during the follow-up periods. Postoperative complications: Regards to postoperative complications, CSF leakage occurs in only one patient of short segment fixation group (3.3%) versus two patients of long segment fixation group (6.7%), also new neurological deficit occurs in only two patients of short segment fixation group (6.7%) versus three patients of long segment fixation group (10%) of insignificant difference between two studied groups (p=0.571). A 10-year follow-up study by Toyone et al. [18] suggested that the benefit of short-segment fixation for burst fractures involving neurological deficit is that it can preserve thoracolumbar motion without resulting in post-traumatic disc degeneration.

There was no deep vein thrombosis, pulmonary embolism, or postoperative infection in all the patients. Time from operation to ambulation in each group was usually 3 to 5 days according to the case-by-case situation of the patients. In Ye et al. [13] study, two patients in short segment fixation group and 1 patient in long segment fixation group group underwent delayed wound healing owing to fat liquefaction. However, the wounds of the 3 patients healed well after dressing change with no CSF leakage in both group. Late postoperative clinical evaluation (after 12 weeks follow up): 67% of short segment had minimal ODI compared to 57% of long segment fixation group. 23% and 10% of short and long segment fixation groups respectively had no pain while 10% and 33% of short and long segment fixation groups respectively had moderate VAS for pain. Mean±SD of PVAS was 3.85 ± 1.88 vs 4.41±1.78 with insignificant differences between them (p=0.241). 60% and 67% of short and long segment fixation groups respectively had moderate ODI while 40% and 33% of short and long segment fixation groups respectively had minimal ODI. Mean±SD of ODI was 22.62 ± 8.46 vs 24.33 ± 9.99 in short and long segment fixation groups respectively with insignificant differences between them (p=0.477). These findings were closer to Steib et al. [19] and Aoui et al. [20] studies.

Follow-up imaging evaluation (12 week after surgery): 12 week after surgery, 7 cases of short segment group presented with implant failure (5 cases with screw breakage and 2 cases with rod breakage) versus to 3 cases of long segment group presented with rod breakage with insignificant differences between them (p=0.167). In agree with our study, Tezeren and Kuru [21], in their study comparing short segment versus long segment fixation in thoracolumbar burst fractures, demonstrated that long segment instrumentation is an effective way to manage thoracolumbar burst fractures. Short segment pedicle instrumentation had a high rate of failure. However, long segment instrumentation prolonged the operative time and increased the amount of blood loss significantly.

Although there were ten “events” in the short segment fixation group and three events in the long segment fixation group, Aly [22] in their results showed that the incidence of implant failure did not differ between the two groups. Change in VAS of pain: In current study, there were insignificant improvements in PVAS in both groups. 7 cases (23%) and 3 cases (10%) of short and long segment group was

improved from mild PVAS to no pain. 7 cases (23%) in both groups were improved from moderate to mild PVAS. 2 cases (6%) in both groups were improved from severe to mild PVAS. 3 cases (10%) of long segment group was improved from severe to moderate PVAS compared to no cases in short segment group (p=0.246). There was significant difference between both groups regards absolute reduction of VAS of pain (Mean±SD: 1.41±0.33 vs 0.50±0.16, p<0.01) and also relative reduction % of VAS in short segment fixation group was significantly higher than long segment fixation group (Mean±SD: 38.52 ± 20.49 % vs 10.18 ± 9.87. %, p<0.01). Similar to current findings, Ye et al. [13], Steib et al. [19] and Aoui et al. [20] series revealed no significant difference in VAS scores before surgery, 1 week after surgery, 6 months after surgery, and 1 year after surgery between the 2 groups.

Change in ODI: There was high statistical significant difference between both groups as regard absolute reduction of ODI (Mean±SD: 5.82±4.12 vs 9.50±1.59, p<0.001), also relative reduction of ODI % was insignificantly lower in short segment than long segment fixation group (Mean±SD: 20.45±32.75 % vs 28.08±13.73%, p=0.244). In Ye et al. [13], ODI scores in both groups were also significantly improved compared to those before surgery. However, as with the VAS scores, no significant difference was observed in ODI scores between the 2 groups before surgery and at all follow-up periods (P=0.44, 0.95, 0.07, and 0.30, respectively).

Conclusions

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 has allowed for more stable constructs, earlier mobilization, and better deformity correction through the use of three column spinal fixation. The short segment open posterior transpedicular fixation technique presents clinical, functional results as regard PVAS and ODI that are significantly better than the long segment open posterior transpedicular fixation technique. As regard radiological correction of cobb's angle at last follow up is significantly better in long segment open posterior transpedicular fixation technique than The short segment open posterior transpedicular fixation technique

Recommendations

Awareness not only of the surgical anatomy but also the radiological anatomy of the thoracic and lumbar spine is crucial in better outcomes and little complications of any pedicle procedure either short segment or long segment open posterior transpedicular fixation. Pre-operative clinical assessment is important clue to evaluate neurological status for best decision making and morphology of fracture as regard recent AOspine classification and measuring angle of kyphosis to be compared with post-operative images. Intra-operative fluoroscopy (C-arm) is an important tool in steps of transpedicular fixation, at end of surgery, operative time, total amount of blood loss and obvious intra-operative complications and recorded in operative sheet. Post-operative and follow up assessment of neurological statue and functional outcome (PVAS & ODI) are done for all cases.

Post-operative and follow up radiological assessment is done for all cases as regard measuring angle of kyphosis to be compared with pre- operative image. Post operative complications: either wound infection, CSF leakage or implant failure must be recorded for better management and prevention.

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