International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 10, 2020
ISSN: 1475-7192

Assessment of Clinical and Radiological of Interbody Fusion and Short Segment Fixation in Dorso-Lumbar Fractures at Zagazig University hospital.

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Abstract

Background:*Thoracolumbar fractures represents nearby 70% of all traumatic spine fractures.There is several classification systems of traumatic thoracolumbar fractures aiming to provide an accepted treatment algorithm in such cases. Surgical treatment has demonstrated better clinical and radiological results than conservative treatment.The aim was to assess the outcome (Clinical and Radiological)of short segment fixation with interbody fusion in dorsolumbar fractures.****Methods:****This study was conducted at the neurosurgery department at Zagazig University hospitals and included 16 cases with thoracolumbar fractures treated by short segment open transpedicular posterior fixation with interbody fusion.****Results:****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. There is statistically significant change in Cobb's angle score at 3 days and 12 weeks postoperatively as compared to preoperative Cobb's angle. Preoperatively, mean angle was 22.25 which significantly decreased to 6.5 then increased to 9.5 with significant fluctuation over time. All the studied patients had no intraoperative or early complications.* ***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.*

Key words: *Dorso-Lumbar Fractures- Interbody Fusion- Short Segment Fixation*

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I. Introduction:

Thoracic vertebrae form the middle segment of the vertebral column, between the cervical vertebrae and the lumbar vertebrae. In humans, there are twelve thoracic vertebrae and they are intermediate in size between the cervical and lumbar vertebrae; they increase in size going towards the lumbar vertebrae, with the lower ones being a lot larger than the upper, They are distinguished by the presence of facets on the sides of the bodies for articulation with the heads of the ribs, and facets on the transverse processes of all, except the eleventh and twelfth, for articulation with the tubercles of the ribs[(1)].

The lumbar vertebrae are, in human anatomy, the five vertebrae between the rib cage and the pelvis. They are the largest segments of the vertebral column characterized by the absence of the foramen transversarium within the transverse process (as it is only found in the cervical region). They are designated L1 to L5, starting at the top. The lumbar vertebrae help support the weight of the body, and allow movement [(2)].

Thoracolumbar junction is generally defined as a region from T10 to L2 vertebral bodies [(3)].

Thoracolumbar fractures represents nearby 70% of all traumatic spine fractures[(4)].

There is several classification systems of traumatic thoracolumbar fractures aiming to provide an accepted treatment algorithm in such cases[(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 it's supporting structures as well as the neurologic status of the patient [(6)].

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 segement or short segement with fusion), anterior or anterior-posterior approaches [(7)].

The aim was to evaluatethe outcome of dorsolumbar fractures after doing interbody fusion of involved fractured motion segment with short segment fixation at Zagazig University hospital.

II. Patients and Methods

1- Technical design:

This was non randomized clinical trial which performed at the Neurotrauma unit of Neurosurgery department, Faculty of medicine, Zagazig University hospitals, Sharkia, Egypt. This study was conducted on 16 patients with traumatic thoracolumbar fractures were collected from june 2019 to march 2020.

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

2- Operational design:

A.Pre-operativeassessment:

Patients were assessed as regards to:

- **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 as follow

The Frankel Grade classification provides an assessment of spinal cord function and is used as a tool in spinal cord injury as follows:

- **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**:
- **Consent is taken from all cases included in the study.**

B. Operative technique (for open posterior transpedicular screw fixation):

All the patients in this study was operated at Zagazig university hospital, neurosurgery department under supervision of our senior staff regard to best decision making consultation.

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 to:

1) Clinically:

- **Neurological state**:regard ASIA classification and patient VAS. The patients were ambulated 24 hours after surgery.
- **Surgical wound evaluation:** regard 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 sagitalrecontraction view):** done in all casesto 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, 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).

III. Results:

Age of patients ranged from 19 to 55 years with mean 37.88 years. Male constituted 68.7% of them half of them came from rural area, 81.3% were married. About one third of them were housewives.

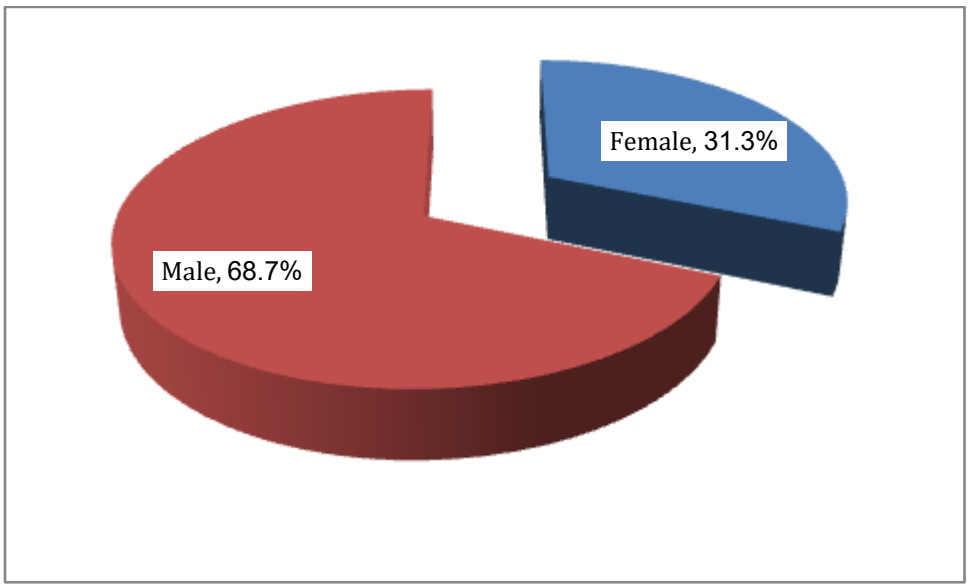

Figure (1) Pie chart showing distribution of patients according to gender

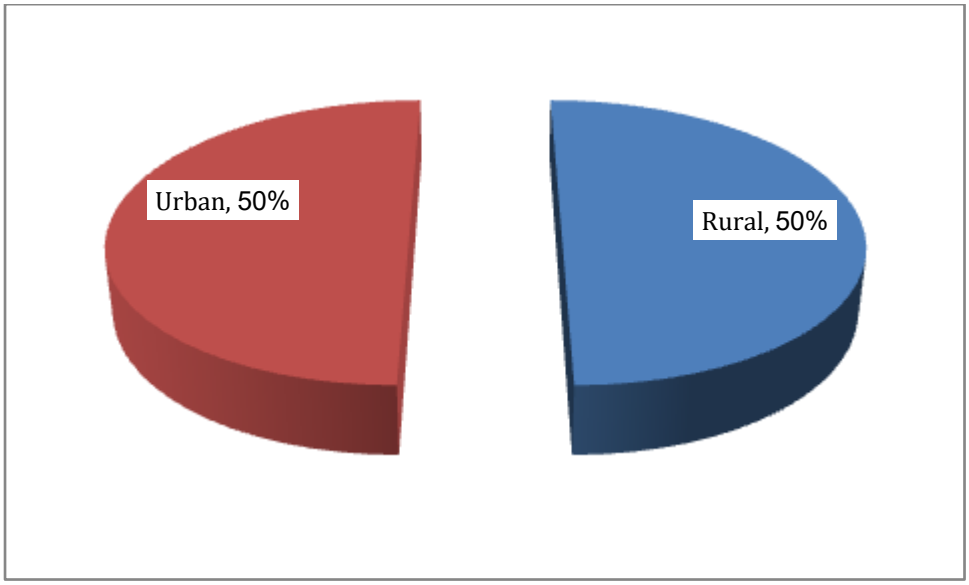

Figure (2) Pie chart showing distribution of patients according to residence

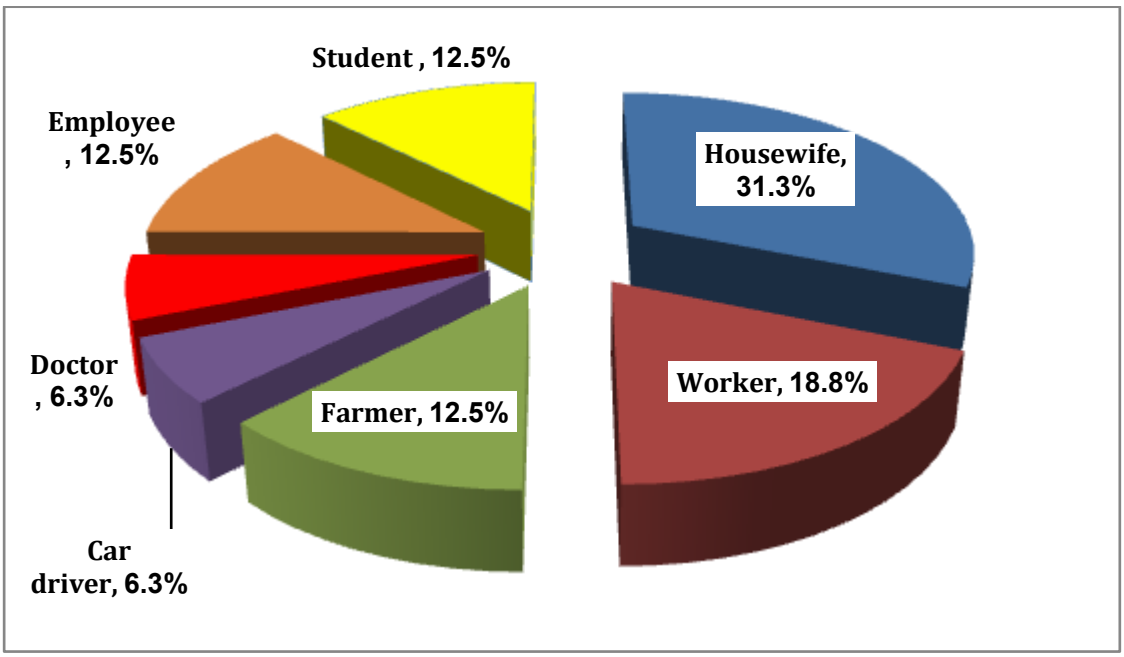

Figure (3) Pie chart showing distribution of patients according to occupation

Table (1) 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:	
A	**0 (0)**
B	**0 (0)**
C	2 (12.5)
D	4 (25)
E	10 (62.5)

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

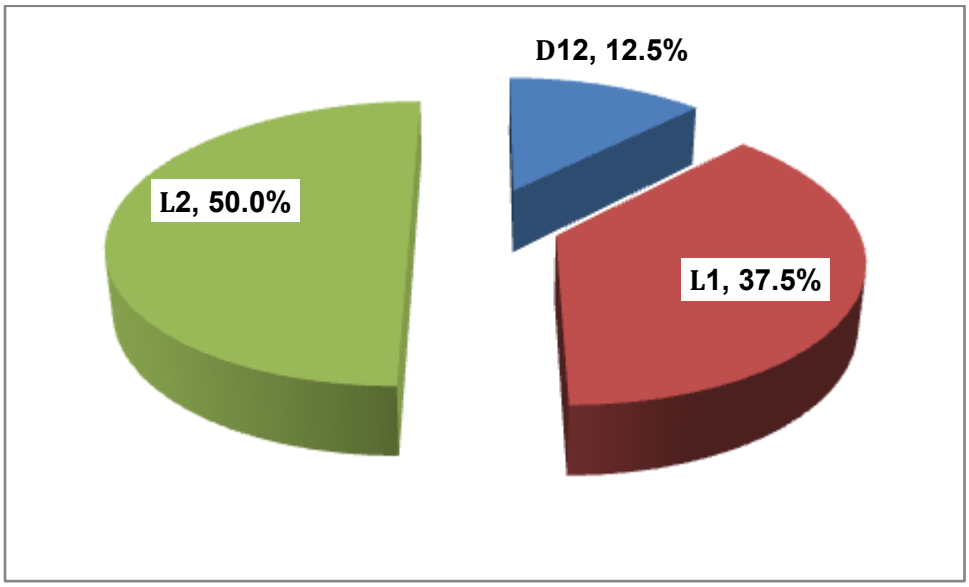

Figure (4) Pie chart showing distribution of patients according to level of fracture

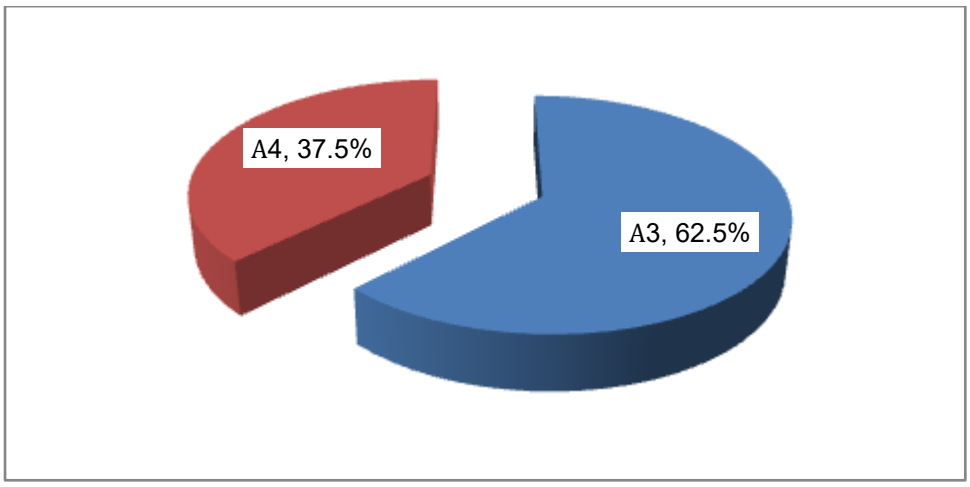

Figure (5) Pie chart showing distribution of patients according to type of fracture

Table (2) Preoperative imaging evaluation of the studied patients:

	N=16 (%)
Cobb's angle	
Mean ± SD	22.25 ± 3.64
Range	16 – 28
Laboratory findings:	
Accepted	16 (100)

Regarding imaging evaluation of Cobb'sangle, it ranged from 16 to 28 with mean 22.25 and all patients had accepted laboratory findings

Table (3) Operative data of the studied patients:

	N=16 (%)
Number of screws	
Mean ± SD	4.5 ± 0.894
Range	4 – 6
System of fixation:	

Atlantis	16 (100)
Type of fixation:	
Cage and bone	16 (100)
Operative time (minutes):	
Mean ± SD	151.25 ± 22.174
Range	120 – 180
Blood loss (ml):	
Mean ± SD	334.38 ± 106.017
Range	200 – 500

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.

There is statistically significant change in VAS score at 3 days and 12 weeks postoperatively as compared to preoperative VAS. Preoperatively, 62.5% had moderate pain preoperative and 37.5% had severe pain. At three days postoperatively, half of patients had mild score, 37.5% had moderate pain, and the remaining 12.5% had severe pain. At twelve weeks, one quarter of patients had no pain, 62.5% had mild pain and remaining 12.5% had moderate pain and improved on adequate medical treatment.

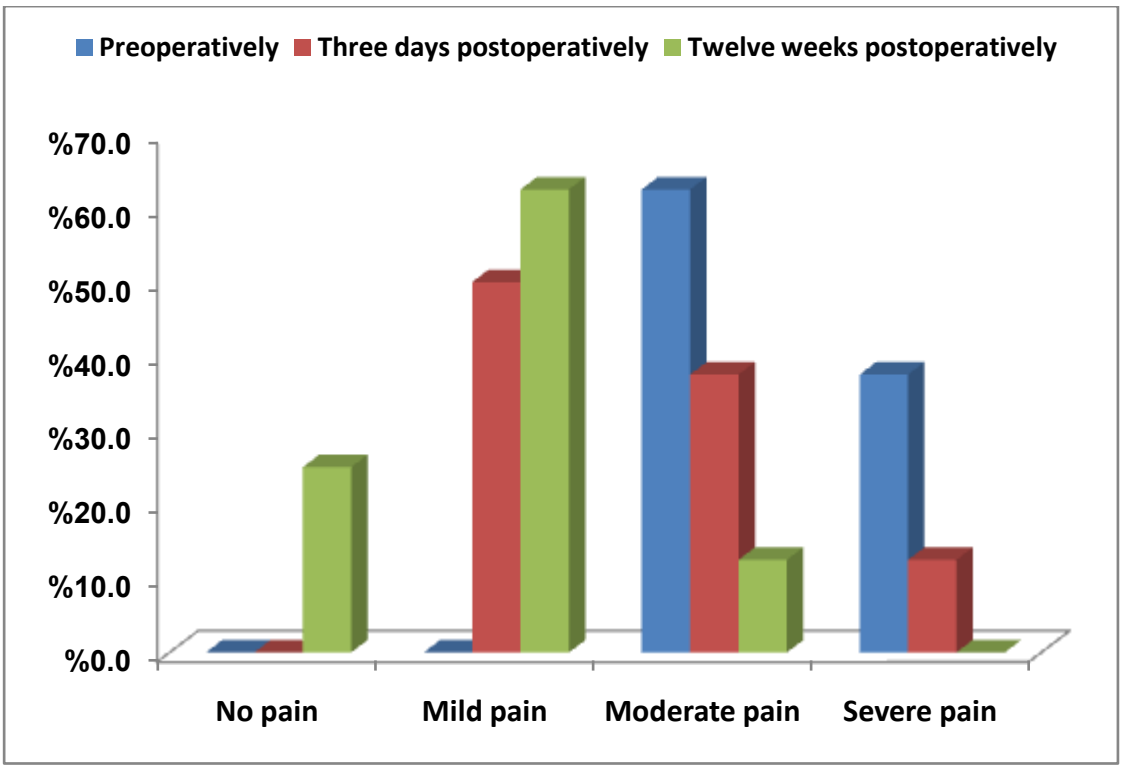

Figure (6) Combined bar chart showing change in VAS score pre and postoperatively among the studied patients

There is 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.

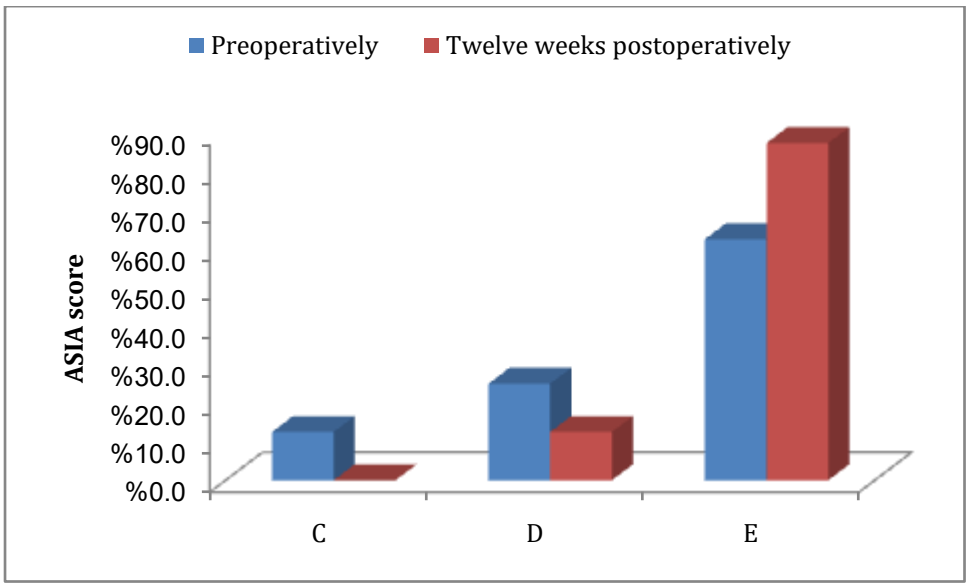

Figure (7) Combined bar chart showing change in ASIA score pre and postoperatively among the studied patients

Table (4) Imaging evaluation 3 days and 12 weeks postoperatively:

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

All the studied patients had accepted laboratory findings pre and postoperatively.

There is statistically significant change in Cobb's angle score at 3 days and 12 weeks postoperatively as compared to preoperative Cobb's angle. Preoperatively, mean angle was 22.25 which significantly decreased to 6.5 then increased to 9.5 with significant fluctuation over time

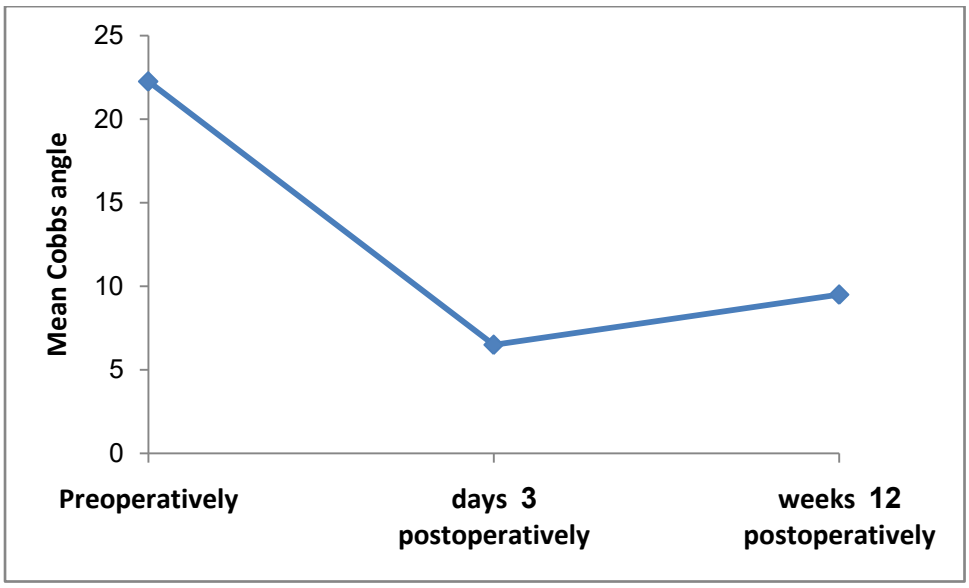

Figure (8) Line graph showing change in mean Cobb's angle pre and postoperatively

Table (5) intraoperative and early complication among the studied patients:

Complications	**N=16 (%)**
Intraoperative, absent	16 (100)
Early , absent	16 (100)

All the studied patients had no intraoperative or early complications

IV. Discussion

The most prevalent type of fracture was **A3 fracture** where it constituted 62.5% of patients, the level of fracture was L2in50 % of patients &about 38% had severe pain as reported on VAS score.

We agree in this with ***HWANG et al.,*** [(8)]whoevaluated 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 was found that Male is the predominant 57% of patients, Mean age was 40.5 ± 12.7 years.

In ***Wang et al.,*** [(9)] study, a consecutive series of 20 patients with isolated thoracolumbar/lumbar burst fractures were treated by posterior short segment pedicle screw fixation and TLIF for the treatment of unstable thoracolumbar/lumbar fracture ,Male was predominant (75%)The patients aged from 18 to59 years (mean 38.4

years). The most prevalent level of fracture is L2 in 9 patients, T12 level in 5 patients, L1 in 2, L3 in 3, and L4 in 1 patient.

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.

Our study agrees with ***HWANG et al., [8]*)**. 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.

This also agrees with ***Wang et al., [9]*** study where neurologic deficit was graded according to Frankel motor score system. 20 patients were as follow: Three patients were classified as Frankel B, 6as Frankel C, 5 as Frankel D, 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.

We also agree with a recent study done by ***El Behairy et al., [10]*** that included 32 patients with thoracolumbar fractures, selected between August 2013 and February 2016. 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.

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.

We agree with ***HWANG et al., [8]***who reported that mean operative time was 152 ± 28 minutes in the fusion group which reflects more time in fusion group than non-fusion group. Mean operative time 117 ± 33 minutes which was attributed due to technique type & mean intraoperative blood loss was 455 ± 78 ml.

There is statistically significant change in VAS score at 3 days and 12 weeks postoperatively as compared to preoperative VAS. Preoperatively, 62.5% had moderate vas of pain preoperative and 37.5% had severe vas of pain. At three days postoperatively, half of patients had mild vas of score, 37.5% had moderate vas of pain, and the remaining 12.5% had severe vas of pain. At twelve weeks, one quarter of patients had no pain, 62.5% had mild vas of pain and remaining 12.5% had moderate vas of pain and improved on adequate medical treatment.

These results are in agree with retrospective study of ***Hwang et al.,*** [8]. In the fusion group the preoperative VAS for back pain was 7.5 ± 1.0, immediate postoperative was 3.9 ± 1.1 and final follow-up 1.6 ± 0.7, while in the non-fusion group the preoperative, immediate postoperative and final follow-up VAS for back pain were respectively7.3 ± 0.8, 3.9 ± 0.8, and 3.4 ± 0.9 as the final result pleaded in favor of fusion ($p < 0.0001$).

These results were in agree with***Parker et al.,*** [11]study, A retrospective review from January 1989 to July 1993 was performed on 38 patients were instrumented by short-segment technique, 44% of patients had no pain; 23% of patients had occasional slight pain with no need for medication; 26% of patients had moderate pain with a need for occasional medication. One patient had moderate to severe pain with aneed for frequent medication and occasional absence from work and one patient had constant or severe incapacitating pain and a chronic need for medication.

We also agreed with a recent study done by***Chokshi et al.,*** [12]that was prospective study of 50 patients of thoracolumbar fractures treated with short-segment fixation with the inclusion of fracture level,Fusion was performed using locally harvested autologous bone grafts after meticulous creation of a fusion bed,The VAS score improved from 8.6 to 2.4 at final follow-up.

Our results are also in agree with ***Altay et al..,*** [13]study, that included 2 Groups ***:*** Group I (short segment fixation group); Pain at the fracture site improved from a mean VAS of 7.8±3.7 preoperatively to a mean of 4.2±8.1 two weeks postoperatively. This was improved to a mean VAS of 1.9±5.4 at final follow-up.

We found that there is statistically significant change in Cobb's angle score at 3 days and 12 weeks postoperatively as compared to preoperative Cobb's angle. Preoperatively, mean angle was 22.25 which significantly decreased to 6.5 then increased to 9.5 with significant fluctuation over time.

we are in agree with ***Wang et al.,*** [9] where Local kyphosis was improved from 16.95° before surgery to 0.15° after surgery and progressed to 0.40°at the last follow-up. There was a significant difference between preoperative and postoperative values ($P < 0.05$) but no significant difference between the values of post operation and last follow-up ($P > 0.05$). On an average, total kyphotic correction was 16.80°

This also agrees with ***George et al.,*** [14]*study*whereshort-segment stabilization and fusion done in 20 cases in which Mean angle was preoperative 17.0° ± 7.0 and decreased to 5.0° ± 3.5 to reach 8.5° ± 6.0 at final visit follow up.

Another study of ***Lee et al.,*** [15]whereCobb's angle was mean of 18.96° ± 8.05 preoperatively. It changed to a mean of 8.62° ± 11.9 postoperatively and to a mean of 16.19° ± 7.52 at final follow-up.

Another recent study done by ***MSE A Elhafez et al.,***[16], A prospective study included Twenty patients admitted to Orthopedic and Traumatology Department of Suhag General Hospital suffering from unstable fracture of thoracolumbar area undergo Posterior pedicle screws fixation one level above the fractured vertebra and one level below it, there was improvement in kyphotic angle, Mean kyphotic angle preoperative was 13.50° and post-operative mean angle was 9.150° with statistically significant P value that was 0.008.

However, our results were not in match with ***Waqar et al., [17],*** from January 2007 to December 2014, discuss a comparison of outcomes between Short and long-segment posterior fixation in the treatment of thoracolumbar junction fractures, where 28 patients were included and divided into 2 groups; in group I (short segment fixation group); cobb's angle was mean of 10.96 ± 7.05 preoperatively. It changed to a mean of 8.68 ± 10.9 postoperatively and to a mean of 12.0679 ± 9.52 at final follow-up. In group II (long segment fixation group): Cobb's angle was mean of 11.724 ± 5.94 preoperatively. It changed to a mean of 10.64 ± 2.47 postoperatively and to a mean of 11.9 ± 3.11 at final follow-up .that the Cobb angle had increased significantly in the SSPF group (paired t-test, p=0.049), but not in the LSPF group.

All the studied patients had no intraoperative or early complications as wound infection, new neurological deficit ,vascular complications ,No patient have presented by implant failure either screw breakage , screw pullout , rod slippage , rod breakage or slipped cross link.

We agreed with ***Wang et al., [9]***as all patients recovered with solid fusion of the intervertebral bone graft, without main complications like misplacement of the Pedicle screw, infection, nerve or vessel lesion or hard ware failure. Two patients experienced cerebrospinal fluid leakage because of initial injury.

But his disagrees with ***HWANG et al., [8]***. Where implant-related problems in the fusion group occurred in 2 patients out of 35 (5.7%),Screw loosening was noted in one patient,Screw loosening was noted in one patient of the fusion group.

In the study of***Moon et al., [18],*** which illustrated that$_{\text{the}}$ number of patients with implant failure in short segment fixation group was 9 patients.

In the study of ***Waqar et al., [17],***outcomes of Short with posterior fixation in the treatment of thoracolumbar junction fractures; there were 7 cases of construct failure, including 3 broken screws and 4 bent screws, within range 3-14 months post operation.

V. 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 has allowed for more stable constructs, earlier mobilization, and better deformity correction through the use of three column spinal fixation.Posterior short-segment pedicle fixation in conjunction with interbody fusion seems to be a feasible option in the management of selected thoracolumbar fractures, thereby addressing all the three columns through a single approach with less trauma and good results.Fusion is advisable to maintain the postoperative kyphosis correction and to reduce the incidence of implant-related complications and back pain.

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