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Posterolateral Approach for Dorsal Spine Fractures

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Abstract

Background: Despite the great evolution in neurosurgical techniques, management of fractures of the thoracic spine still represent a major conflict in neurosurgery due to the different causes leading to fracture and the different methods available for management. The thoracolumbar region anatomically from D11-L2 which loss the stabilization effect of the rib cage. The spinous processes are more horizontal, which provides increase mobility.

Objective: The aim of this study is to evaluate the efficacy and success of posterolateral approach for treatment of dorsal spine fractures surgically.

Patients and methods: This was a prospective study of 30 patients of both sexes having all types fractures in the dorsal region (whether traumatic or pathologic) managed in the period between October 2015 and September 2017 in Neurosurgery Department Minia and Al-Azhar University hospitals. The study was approved by the medical ethics committee of Minia and Al-Azhar University Hospitals and a written informed consent was obtained from all patients.

Results: Among the 30 patients, 14 of them managed by transpedicular screws fixation, 11 patients managed by costotransversectomy with pedicular screws fixation, and 3 patients managed by costotransversectomy with pedicular screws fixation and interbody cage insertion while one case managed by LECA with pedicular screws fixation and another one case with LECA with both pedicular screws and interbody cage insertion. Among the 30 patients managed 25 of them improved and 5 patients did not show any improvement during management.

Conclusion: The ideal methodology in managing fractures should be meticulous pre-operative, operative, and postoperative management. The preoperative management should entail detailed and through clinical neurological evaluation to point out the presence of preoperative neurological deficit and their extent.

Keywords: Dorsal Spine Fractures, LECA, CT, Surgery, Management

Introduction

Development of posterolateral approach has passed through different stages that created a breakthrough in management of spine fractures either traumatic or pathologic. The main historical aspects of the evolution of transpedicular fixation of the spine were analyzed according to the literature. The main historical stages in the development of transpedicular fixation of the spine were identified: vertebral screw fixation **(1),** pedicle screw plate system **(2),** external transpedicular fixation – Fixateur Externe **(3),** internal transpedicular fixation – Fixateur Interne, transpedicular titanium implants. They played a significant role in the formation of modern surgical technologies for posterior metallic osteosynthesis and the creation of multifunctional transpedicular fixation devices, which are now considered to be the gold standard of posterior fixation for various pathologies of the thoracic, and lumbosacral spine **(4).**

A costotransversectomy approach enables posterior stabilization with a more thorough decompression of the canal than can be achieved with a transpedicular approach because it enables more thorough bony removal **(5)**.

The lateral extracavitary approach (LECA) to the thoracic and lumbar spine was originally developed by **Capener** **(6)** for the treatment of tuberculous spondylitis. The original procedure was modified to expand its application to other anterior spinal column pathologic findings (eg, fractures, infection, thoracic disk disease) and to allow for the placement of posterior instrumentation **(7)**. This modified LECA differs from Capener's spinal exposure in the configuration of the skin incision and in the mobilization of the erector spinae muscle group, which are dissected along

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the lateral border and retracted medially along the length of the incision [8].

Fractures of thoracic vertebrae can be classified into traumatic, pathological, osteoporotic and inflammatory [9]. Any type can cause compression of the cord leading to neurological deficit [10].

The thoracolumbar junction is the most common area of injury to axial skeleton. A wide variety of injury patterns and clinical presentation are encountered in this region, and multiple classification systems have been advised according to three column theory [11].

The thoracic region is more stable than the thoracolumbar region as the thoracolumbar region lacks the stabilizing effect of the rib cage. The spinous processes are more horizontal, which provides increase mobility, so this region have greater mobility [12].

Goals of any form of treatment are to obtain a painless, balanced, stable spine with optimum neurological function and maximum spine mobility [11].

Aim of the Work

The aim of this work was to evaluate the efficacy and success of posterolateral approach for treatment of dorsal spine fractures surgically.

Patients and Methods

This was a prospective study of 30 patients having all types fractures in the dorsal region (whether traumatic or pathologic) managed in the period between October 2015 and September 2017 in Neurosurgery Department Minia and Al-Azhar University Hospitals.

Ethical approval:

The study was approved by the medical ethics committee of Minia and Al-Azhar University Hospitals and a written informed consent was obtained from all patients.

Recently traumatized patient received initial care by a trauma team that includes general surgeon, orthopedic surgeon, neurosurgeon and cardiothoracic surgeon. Each patient was thoroughly examined by these specialties. Vital functions (airway, breathing and circulation) were well assessed and any dysfunction was well managed by the team. Once the patient was hemodynamically stabilized, a diagnostic work up was done for him with suspected spine injury includes conventional x-ray radiography and computed tomography to identify level of injury and type of fracture. Once the fracture was identified and classified, a treatment plan was prepared based on fracture pattern, severity of injury and patient's overall condition.

The rationale of this work was to evaluate the different treatment modalities for fractures of the dorsal region as a trial to establish a proper algorithm in the management of these cases.

The treatment modalities included posterior and posterolateral approach i.e. surgical decompression and fixation.

Patients of all ages and both sexes were included in the study.

Inclusion criteria:

- Patient with fractures of dorsal spine.
- Anterior bone loss.
- Anterior medullary compression causing incomplete neurological deficit.
- Age from twenty years to seventy years old.

Exclusion criteria:

- Associated chest pathology inducing respiratory insufficiency such as pulmonary contusions.
- Morbid obesity causing the procedure to be technically very difficult.
- Age below twenty years or above seventy years old.
- Conditions better treated by anterior approach.
- Stable fractures.
- Patients medically unfit for surgery.

METHODOLOGY

Pre-operative Patient Evaluation:

Each patient was evaluated clinically, radiologically and by other preoperative laboratory investigations to confirm fitness for general anesthesia.

Clinical evaluation:

- ***History*:**
  - Personal history.
  - Present history.
  - History of trauma.
  - Neurological disorders.
  - Past history.
- ***Examination*:**
  - General examination
  - Spine examination.
- **Neurological evaluation:**
  a- Sensory examination.
  b- Motor examination for muscle power.
  c- Reflexes:

- Superficial: abdominal reflexes, planter reflex
- Deep: Knee reflex, ankle reflex

▪ **Radiological investigations:**

The diagnostic modalities that can be used to identify thoracic fractures range from simple plain radiography to CT and MR imaging. Each imaging modality has its advantages and drawbacks. The complete evaluation of a patient with a thoracic fracture will include a combination of various imaging techniques. It included pre-operative plain X-ray (AP, lateral views) were used as a routine screening for all patients, CT scan (without contrast) and MRI (T1W, T2W, and T1W with contrast if a neoplastic lesion is suspected). MR imaging is the imaging modality of choice for assessing soft tissues, including the spinal cord and was used as a complementary diagnostic modality for all patients in this study.

a- *Analysis of plain X-ray***:** Multiple parameters were selected for comparison between the pre-operative, immediate post-operative and long follow up X-ray.

*Vertebral body angle***:** It is the angle formed between a line parallel to superior end plate and a line parallel to inferior end plate of the injuried vertebra on the lateral film.

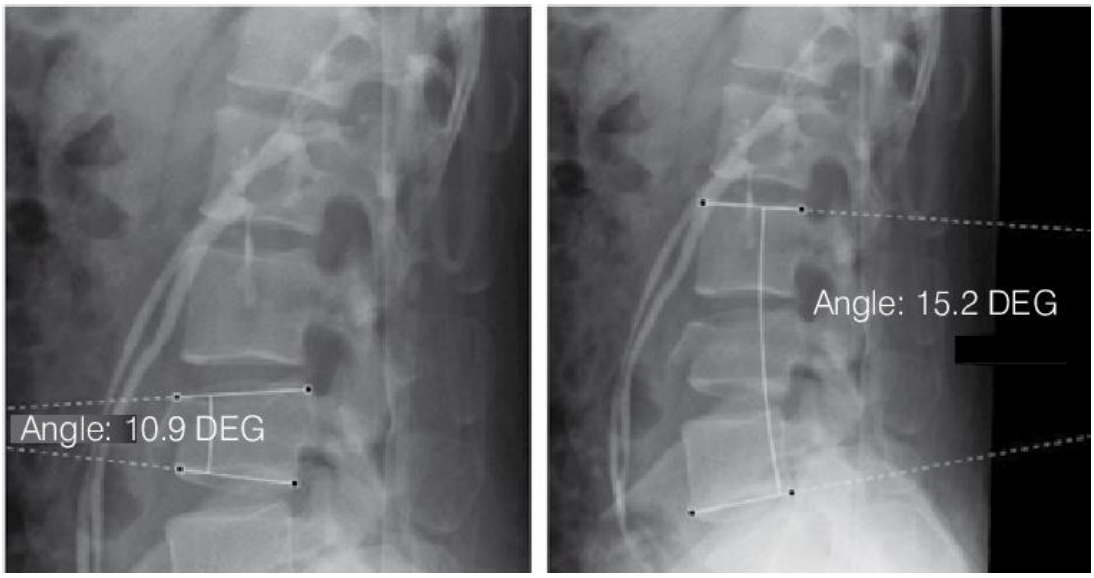

Fig. (1): Vertebral body angle

*Local kyphosis***:** This angle is measured by Cobb's method; the angle between two lines, the 1st perpendicular to superior end plate of vertebra above and the 2nd is perpendicular to inferior end plate of vertebra below.

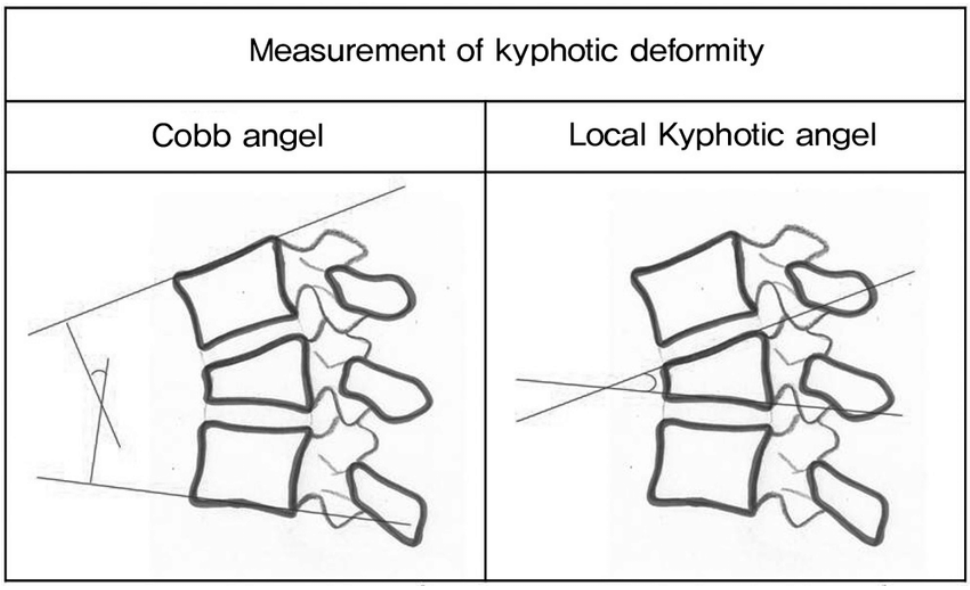

Fig. (2): Measurement of kyphotic deformity.

*Wedge index***:** Equals the anterior vertebral body height divided by the posterior body height.

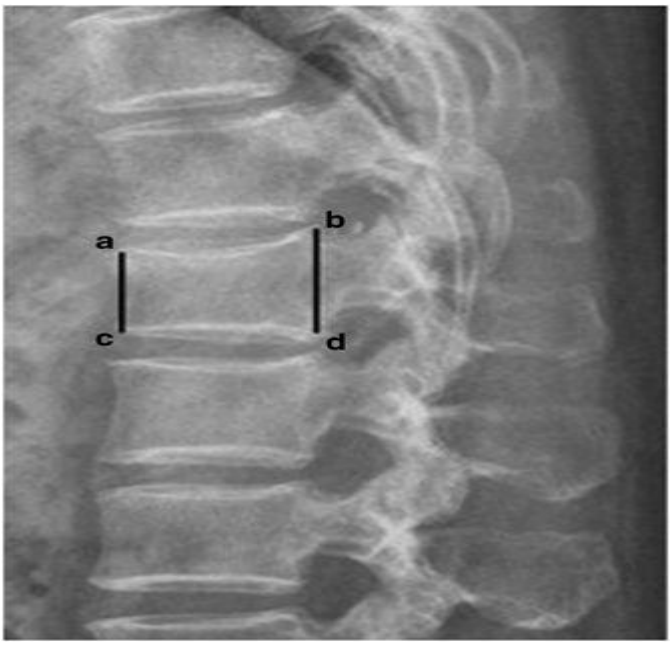

Fig. (3): Wedge index

b- Analysis of CT scan:

-Mid sagittal diameter of the neural canal of the affected level in comparison with the normal level above and normal level below at the pedicles level. Normal mod sagittal diameter of the affected level = (A+B)/2 in which A is the mid sagittal diameter of the neural canal of the normal vertebra above and B is the mid sagittal diameter of the neural canal of the normal vertebra below. The most severe spinal canal compromise was identified and to estimate canal clearance.

Management:

According to the clinical evaluation and the radiological assessment the proper management was decided.

Options used in the management were either posterolateral and\or posterior surgical decompression and fixation however cases that need Conservative management, Vertebroplasty alone or vertebroplasty combined with surgical decompression and fixation or anterior approach were excluded.

Surgical decompression and fusion: Posterior and posterolateral decompression and fusion were both tried in this study.

Pre-operative Management

Patients, who had evident lower limb weakness rendering them not ambulant, were closely monitored for proper hydration and were given prophylactic dose of short acting anticoagulants (fractionated low molecular-weight Heparin); 1 units/Kg/day in patients and those with previous history of deep venous thrombosis. These anticoagulants were stopped 12 hours before surgery.

Patients who had history of or turned out "on examination or by investigations", to have medical disorders such diabetes or hypertension, were subjected to proper assessment and were given the proper corresponding medications.

All patients were given 1 gm of a third-generation cephalosporin 6 hours before surgery (after performing an intra-dermal sensitivity test) and after induction of anesthesia.

Postoperative Management:

All patients were kept in an intermediate care unit for the first postoperative 24 hours, then they were transferred to the regular patients' ward.

Laboratory analysis including; hemoglobin, serum electrolytes, renal functions and hepatic enzymes were performed in the early postoperative period and the fluid balance was recorded throughout the period of hospital stay.

-All patients were neurologically tested postoperative.

-All patients were fitted in thoracolumbar after the surgery.

-No movement restriction for patients whom had only fracture spine. The patient was allowed to sit, stand and walk when was capable of doing with the brace, 2nd day of surgery plain X-ray is done.

-All patients were instructed to wear their brace during movement and take it off before going to sleep.

Patients were given 1 gm of third generation cephalosporin intravenously once postoperative unless infection or wound collection was noticed, where in such cases IV antibiotics were continued.

Patients were also continued on steroids in certain cases in gradual tapering doses.

All patients were subjected to a complete and detailed postoperative neurological clinical evaluation comprising cranial nerves, motor and sensory functions.

All patients had a postoperative control X-ray.

Patients having motor weakness were closely monitored for proper hydration and prophylactic anticoagulants were resumed in addition to physiotherapy.

Follow-up and Outcome:

All patients were followed up at intervals of 1 month, 3 months, 6 months and 1 year whenever possible as ten patients didn't show at their scheduled follow updates.

Follow up included detailed neurological examination to evaluate the neurological deficits that the patients already had, and to detect any new neurological deficits the patients developed during the follow up period.

Follow up also included radiological evaluation by X-ray ± CT scan and in some cases may need to be evaluated by MRI.

The outcome of patients was graded according to the patients' clinical and functional status in the last follow up visit they showed up at. The outcome was graded into 4 groups:

- Excellent: Patients were considered to have an excellent outcome if they had successful surgical outcome compatible with the pre-operative surgical planning without the occurrence of new neurological deficits or permanent complications.
- Good: Patients were considered to have a good outcome if they had successful surgical outcome compatible with the pre-operative surgical planning with the occurrence of transient new neurological deficits or transient deterioration of pre-existing

neurological deficits, provided that they were able to perform their daily activities without or with minor assistance.

- Fair: Patients were considered to have a fair outcome if they had new neurological deficits or permanent deterioration of their pre-existing neurological deficits rendering them dependent on others in performing their daily activities.
- Poor: Patients were considered to have a poor outcome if they had deterioration of their pre-existing neurological deficits anchor new neurological deficits, to the extent that they were not able to perform their daily activities without major and complete assistance, totally bed ridden, comatosed requiring hospitalization or eventually died.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

- Independent-samples t-test of significance was used when comparing between two means.
- Chi-square (x^2) test of significance was used in order to compare proportions between two qualitative parameters.
- The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following:
- Probability (P-value)
  - P-value <0.05 was considered significant.
  - P-value <0.001 was considered as highly significant.
  - P-value >0.05 was considered insignificant.

Results

This study included 30 patients having all types of fractures in the dorsal region managed in the period between October 2015 and September 2017 in Neurosurgery Department Minia and Al-Azhar University hospitals.

We have two groups of fractures:

(1) Traumatic group: 19 (63.3%) patients.

(2) Pathological group: 11 (36.7%) patients

(I) TRAUMATIC GROUP

Table (1): Demographic characteristics of traumatic group

	N	%
Sex		
Females	11	57.9
Males	8	42.1
Age group		
20-40	9	47.3
> 40-60	7	36.8
> 60-70	3	15.9
Age of male Range (mean ± SD)	20-70 (44.3±15.9)	
Age of female Range (mean ±SD)	20-70 (41.8±15.4)	

Traumatic group involved 8 males (42.1%) and 11 females (57.9%) aging from 20 to 70 years. Mean age of males was44.3±15.9 years old, while mean age of females was 41.8±15.4.

From the 19 patients with traumatic fractures; 9 were aging 20-40 years (47.3%) and 7 were aging 40-60 years (36.8%), while 3 patients were aging 60-70 years (15.9%).

Table (2): Associated injuries

Injuries	N	%
Thorax		
Fractures of thoracic cage	1	36.8
Hemothorax	1	5.3
Pulmonary contusion		5.3
Abdominal		
Splenic laceration	2	10.5
Pancreatic contusion	1	5.3
Spinal		
Pelvis	2	10.5
Other segments	3	15.8
Limb fractures	3	15.8

Table (2): shows 9 patients (47.4%) with associated lesions. Seven patients (36.8%) presented with fractures of the thoracic cage (ribs, scapulae, clavicle and sternum); one of them had a hemothorax and/or pneumothorax and one had a pulmonary contusion. Three

patients (15.8%) presented with abdominal injury: one pancreatic contusion and two splenic laceration. Three (15.8%) had spine fractures of other segments and 2 (10.5%) had a pelvic fracture. Finally, 3 patients (15.8%) presented limb fractures.

Table (3): Number of level fixed

Number of level fixed	No	%
One level above and below fracture	15	78.9
More than one level above and below fracture	4	21.1

About 79% of patients need fixation one level above and below fracture. While, 21.1% need fixation in more than one level above and below fracture.

Table (4): Comparison between VBA, LK, WI and CTSD before and after the surgery.

	N	Mean ± SD	P value†
VBA pre VBA post	16	20.8±9.9 10.9±9.1	<0.001*
LK pre LK post	19	22.7±14.3 10.4±8.9	<0.001*
WI pre WI post	16	0.5±0.1 0.8±0.09	<0.001*
CTSD pre CTSD post	12	45.4±16.8 30.1±14.7	0.014*

† Paired t test was used.

Table 4: shows that VBA, LK, WI and CTSD were significantly different before and after the surgery.

I) PATHOLOGICAL GROUP

Table (5) Demographic characteristics of pathological group

	N	%
Sex Females Males	 7 4	 63.6 36.4
Age group 20-40 > 40-60 > 60-70	 2 6 3	 18.2 54.5 27.3
Age of male Range (mean ± SD)	25-62 (47 ± 16.3)	
Age of female Range (mean ± SD)	37-66 (52.9 ± 9.8)	

Pathological group involved 4 males (36.4%) and 7 females (63.6%) aging from 20 to 70 years. Mean age of males was47±16.3years old, while mean age of females was 52.9±9.8. From the 19 patients with pathological fractures; 3 were aging 20-40 years (18.2%) 5 were aging > 40-60 years (54.5%), while 3 patients were aging > 60-70 years (27.3%).

Table (6): Frequency distribution of the patients according to management

Type of fixation	Traumatic Group	Pathological Group	Total
	No (%)	No (%)	No (%)
Pedicle screws only	10 (52.6)	4(36.3)	14 (46.7)
Pedicle screws + costotransversectomy	8 (42.1)	3 (27.3)	11 (36.7)
Pedicle screws + costotransversectomy+cage	1(5.3)	2 (18.2)	3 (10)
Pedicle screws +LECA	-	1(9.1)	1 (3.3)
Pedicle screws +LECA+cage	-	1(9.1)	1 (3.3)

Fourteen patients were managed by Transpedicular fixationalone (46.7%), 11 patients were managed by Costotransversectomy with pedicular fixation only (36.7%), 3 patients were managed by Costotransversectomy with pedicular fixation and cage insertion and 2 patients were managed by lateral extra cavitary approach.

Table (7): Comparison between motor function and pain score before and after the surgery

	N	Mean ± SD	P value†
Motor function Pre Post	11	 4.1±1 4.7±0.5	0.02*
Pain score Pre Post	11	 0.6±0.2 0.5±0.15	<0.001*

† Paired t test was used

Table 7 shows that motor function was significantly improved after the surgery (p=0.02). Pain was significantly relieved after the surgery (p <0.001).

Table (8): Complications

	N	%
Bleeding	0	0
Infection	1	3.3
Implant malposition	1	3.3
Pulmonary embolism	1	3.3
DVT	1	3.3
CSF	0	0
Bed sore	0	0
Total	4	13.3

From the 30 patients, we had 4 complicated patients. One of them had infection, 1 of them implanted malposition, 1 patient had DVT and one patient had pulmonary embolism.

Table (9): Follow up after 6 months

	Transpedicular fixation Alone N=14	Transpedicular + Costotransversectomy N=14	Transpedicular +LECA N=2
Fusion rate	11(78.6 %)	13(92.9%)	2 (100%)
Hardware failure	2 (14.3%)	1 (7.1%)	0
Progressive Kyphosis	1 (7.1%)	0	0

After following the patients for 6-months, 11 patients with transpedicular alone showed complete fusion, 2 patients had hardware failure and 1 patient had progressive kyphosis. 13 patients with transpedicular and costotransversectomy approach showed complete fusion and only one patient had hardware failure. All patients with posterolateral fixation showed complete fusion.

Discussion

Our study followed the progress of 30 patients with traumatic and pathological fractures admitted to our hospitals. We had 12 males and 18 females. In traumatic group, age ranges from 20-70 years old with mean age of males was 44.3 ±15.9 years old, while mean age of females was 41.8±15.4. Age ranged from 20-70 years and this result approximate the range reported by **Bartolome´ *et al.*** **(13)** who studied injury profile and outcomes 123 patients with traumatic nonpathological thoracic spine fractures, and they found that age ranged from 19-72 years. However, in the current study 63.2% of fractures resulting from fall From height, while 36.8% resulting from road traffic accident and this is the reverse to what was found by **Bartolome´ *et al.*** **(13)** who reported that motor vehicle accident was the most frequent injury mechanism (48%), followed by fall from a height (43.1%), and this difference could be explained by in the mentioned study 44 male (86.3%) and 7 female (13.7%) were studied. So, the percentage of males was higher than our study and motor car accidents are higher among males than females.

In the present study, about 9 (47.3%) patients had burst fractures, 7 (46.8%) had wedge compression fractures, and 3 (15.9%) patients had dislocation. These figures differ from the study conducted by **Domenico *et al.*** **(14)** who observed that 42%, 30% and 28% of patients had burst fracture, fracture dislocation and compression fracture respectively. This difference may be attributed to different mechanism of injury. The types of spine fracture in a study conducted by **Croce *et al.*** **(15)** were wedge in 50%, burst in 31%, and flexion dislocation in 10%.

In the current study, 9 patients (47.4%) had associated lesions. Seven patients (36.8%) presented fractures of the thoracic cage (ribs, scapulae, clavicle and sternum); one of them had a hemothorax and/or pneumothorax and one had a pulmonary contusion. Three patients (15.8%) presented with abdominal injury: one pancreatic contusion and two splenic laceration. Three patients (15.8%) had spine fractures of other segments and 2 (10.5%) had a pelvic fracture. Finally, 3 patients (15.8%) presented with limb fractures. These results approximate what were found by **Bartolome´ *et al.*** **(13)** who concluded that a thoracic spine fracture must be suspected in any patient with multiple injuries after a high-energy trauma. Given the anatomically congested area that surrounds the thoracic spine, fractures in this segment may be difficult to identified using only plain X-rays. To avoid under diagnosis, a CT scan should be obtained. In addition, complementary MRI allows an accurate evaluation of the soft tissues (inter-vertebral discs, ligaments and spinal cord) **(16)**.

In our study, in VBA pre-operative was (20.8 + 9.9) and post-operative was (109 + 9.1) in 16 cases with p value < 0.001, LK pre-operative was (22.7 + 14.3) and postoperative was (10.4 + 8.9) in 19 cases with p value < 0.001, WI pre-operative was (0.5 + 0.1) and

post-operative was (0.8 + 0.09) in 16 cases with p value < 0.001, and CTSD preoperative was (45.4 + 16.8) and CTSD post-operative was (30.1 + 14.7) in 12 cases with p value = 0.014.

In pathological fractures group age ranged from 20-70 years old with mean age of males was 45±16.8 years old, while mean age of females was 49.3±17.4. According to the site of fractures,4 patients had fracture at Upper dorsal D1-D6 (26.4%), 12 patients at lower dorsal D7-D12(63.1%) and 3 patients with multiple level fractures (10.5%), while other study, **Kerwin *et al.*** [17] had 56.9% dorsal fractures.

In pathological group, about 6 patients had tumor/metastatic cause (54.5%) and 1 patient had osteoporosis (9.1%). According to **Frank *et al.*** [18] in which metastatic pathology about (53%). In osteoporosis pathology, result obtained by **Voormolen *et al.*** [19] mean age 75 years old.

In the current study, 3 patients had tuberculosis (27.3%), and one patient had osteomyelitis (9.1%). Regarding thoracic spine infection, the thoracic vertebrae are the most common site of nonpyogenic spondylodiscitis, and the second most common site of pyogenic spinal infections [19]. Most cases of infectious thoracic spondylodiscitis can be managed non surgically with antibiotics for a minimum of 4 to 6 weeks, and immobilization with a brace or other forms of supportive care. Indications for surgery include neurological deficits and spinal instability with risk of injury to neurological structures, and relative indications for surgery include infection resulting from an unknown pathogen, poorly controlled infection, and intractable pain [20].

In our study, according to clinical presentation, 15 patients had sensory affection (50%), 12 patients had motor affection (40%), 3 patients had sphincteric affection and all of them complained from pain at time of presentation. Compare to other study, the pain was the main presentation in all patients according to **Voormolen *et al.*** [19]**.**

In this study 14 patients were managed by Transpedicular fixation alone (46.7%), 11 patients were managed by Costotransversectomy with pedicular fixation only (36.7%), 3 patients were managed by Costotransversectomy with pedicular fixation and cage insertion. While other study performed by **Schinkel *et al.*** [21] cases were managed by Ventrodorsal approach, posterior transpedicular stabilization and endoscopic anterior fusion.

In the present study, one patient was managed by lateral extracavitary approach with pedicular screws only and another one managed by lateral extracavitary approach with pedicular screws and cage insertion and those fractures were pathological. The LECA is an established option for approaching a wide variety of ventral and ventrolateral pathologies affecting the thoracolumbar spine. This includes disc herniation, tumor (intradural, dumbbell, and metastatic), infection, deformity, and trauma. It is unique in its ability to allow ventral decompression in addition to posterior instrumentation through a single incision [22].

In our study, pain improved in (100%) of the patients and sensation improved in (33.3%) of cases while motor improved in (43.3%) of cases. **Defino *et al.*** [23] state the evaluation of pain according to Denis scale showed that (44%) of patients had no pain after surgery, (22%) had minimal pain not requiring anti-inflammatory drugs, (17%) had moderate to severe pain.

In the current study, the total complication rate was 13.3% which is much lower than what was detected by **Jandial and Chen** [24] who found that the total complication rate was 43% and this difference may be attributed to all patients in this previous study suffered from spinal oncologic pathology which causes significant morbidity in 5%–10% of patients with cancer. Improved imaging techniques and an increased use of surveillance imaging have led to earlier diagnoses of spinal metastases which allow for minimally invasive treatments such as radiation therapy and kyphoplasty.

In a study conducted by **Cao *et al.*** [25]**,** the results of postoperative complications indicated that transient spinal cord dysfunction induced by spinal cord edema occurred in 2 patients; cerebrospinal fluid leak induced by adhesions between ventral dural and intervertebral disc and posterior longitudinal ligament also occurred in 2 patients; dural laceration occurred in 1 patient. These compli-cations were all cured after active targeted treatment. This study suggests that there are

certain associations between complications and operative procedures. During the operation, we should seek to take the lateral approach to avoid spinal cord injury and incrementally separate the tissues adhering to dural mater to avoid dural rupture which would lead to cerebrospinal fluid leak. Hormone is administered before the surgical decompression to reduce spinal inflammation.

After following the patients for 6-months, 11 (78.6%) patients with transpedicular alone showed complete fusion and this was very close to what was detected by **Knob *et al.*** [(26)] who studied the fate of the transpedicular intervertebral bone graft after posterior stabilization.

Three patients were managed by Costotransversectomy with pedicular fixation and cage insertion and in a study conducted by **Shin *et al.*** [(27)] they concluded that Posterior Thoracic Cage Interbody Fusion (PTCIF) be safe and achieved good outcomes for spinal cord decompression and bone fusion. Moreover, spine surgeons might be very familiar with PTCIF. This procedure may be particularly helpful to patients who cannot be undertaken anterior thoracic approach because of comorbidity. Therefore, the authors propose that PTCIF may be a good alternative procedure for posterior thoracic decompression and fusion surgery.

Thirteen patients with transpedicular and costotransversectomy approach showed complete fusion. This agreed with **Zhang *et al.*** [(28)] who observed complete cure and fusion in all 7 studied patients. Also, this result was in coherence with **Shin *et al.*** [(27)] who detected successful bone fusion in all patients more than 3 months after posterior thoracic cage interbody fusion.

All patients with lateral extra cavitary approach showed complete fusion and there were no cases of neurological worsening. There was no mortality. These results were the same observed by **Resnick and Benzel** [(29)]. But in a study by **Jandel and Chen** [(24)] one patient had a neurological deficit postoperatively. This patient was intact immediately after surgery; however, he developed coagulopathy and an epidural hematoma over the next 24 h. Despite evacuation, patient's paralysis did not resolve. The lateral extracavitary approach was developed in part by Norman Capener and then modified by Sanford Larson and others. Many of its advantages arise from the ability to avoid morbidity associated with anterior or lateral incisions [(6)].

An advancement that has made the lateral extra cavitary approach for tumor resection less difficult is the increasing sophistication of expandable cages that allow for easier insertion. Furthermore, in situ expansion allows for the distraction and correction of deformity. This approach also avoids complications related specifically to methylmethacrylate (thermal injury, extravasation, dislodgement) and strut grafts. Balancing the advantages of expandable cages is the potential for subsidence. Whether this occurs due to overexpansion, poor bone quality, or as a result of the use of smaller cages is unclear [(30)].

Conclusion

Despite the evaluation achieved in neurosurgery in the last decade; management of thoracic fractures still represents a challenge that requires proper solving and adjustment of a complex multifactorial equation in order to achieve an accepted outcome.

The ideal methodology in managing fractures should be meticulous pre-operative, operative, and postoperative management.

The preoperative management should entail detailed and through clinical neurological evaluation to point out the presence of preoperative neurological deficit and their extent. It should also include proper radiological evaluation including CT scan MRI with or without contrast especially in pathological fractures.

Management in traumatic group depend on type of fracture (burst, wedge and dislocation), while in pathological fractures management depend on type of pathology such as, osteoporotic fractures, metastatic fracture, TB and osteomyelitis which as regard our study can be treated either by posterior decompression and fixation or by posterior fixation and interbody fusion followed by spinal radiotherapy in metastatic cases.

Postoperative, the patients must be closely followed up and rehabilitated for their neurological deficits, in parallel to receiving the proper adjuvant radio or chemotherapy, in order

to reach the maximum functional neurological outcome.

Finally, it is wise the neurosurgeons, select the maximum available techniques to reach a desirable function neurological outcome, and thus providing a good quality of life for such patients.

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