

# Anterior Approach for Lesions in the Thoracolumbar Area: Evaluation of the Clinical and Radiological Outcome

**Alaa A. Farag, MD., Moataz A. Elawady, MD.**

*Neurosurgery Department, Banha University, Banha, Egypt.*

## **Abstract**

**Background Data:** The primary indications for anterior approach in vertebral surgery include the conditions associated with the destruction of one or more vertebral bodies and intervertebral discs, vertebral fractures, and deformities.

**Purpose:** To evaluate the clinical and radiological outcome of the anterior surgical approach in the management of lesions of the thoracolumbar area.

**Study Design:** A retrospective clinical case study and a literature review.

**Patients and Methods:** Between January 2007 and January 2011 a total of 15 patients admitted and surgically treated for thoracolumbar spine lesion. All patients underwent anterior thoracolumbar fixation surgery. Data were analyzed retrospectively. The outcome was evaluated with (ASIA) scale after three months, six months and one year following surgery. Plain x-Ray both anteroposterior and lateral views and 3D Computed Tomography were done postoperatively.

**Results:** Fifteen patients, 10 males and 5 females with ages ranging from 17 to 70 years were included in this study. They were operated upon for traumatic fracture in 10 patients and TB spondylodiscitis in 5 patients in the thoracolumbar area. The average operative time was 4 hours. The average postoperative hospitalization was 14.5 days. According to ASIA; patients grade A (N=5), and E (N=2) remained the same post-operatively, whereas, of the other patients with incomplete cord lesion (N=8), six improved one grade and two did not improve. The preoperative segmental kyphosis improved postoperatively at the three-month visit from a mean of 26.2° to a mean of 11°.

**Conclusion:** Anterolateral approach can be an effective means of treating thoracolumbar spine lesions. It allows better safe decompression of neural structures. The titanium cage and Z-Plate system provide efficient stability and allows for early mobilization. (2012ESJ030)

**Keywords:** thoracolumbar, anterolateral approach, Z-plate

## Introduction

The thoracolumbar region is generally accepted as that part of the spine formed by vertebrae from the 11<sup>th</sup> thoracic to the 2<sup>nd</sup> lumbar.<sup>8,12</sup> The primary indications for anterior approach in vertebral surgery include the conditions associated with the destruction of one or more vertebral bodies and intervertebral discs, vertebral fractures and deformities.<sup>10,16</sup> While patients with deformities constitute the main patient population in childhood and adolescence, degenerative diseases, malignancies, and infections are the prevailing indications among adults. Recently, traumatic fractures with or without neurologic deficits also represent another very important indication for the anterior approach in spinal surgery. Pain relief, stabilization of the deformity, drainage of

spinal infections, and improvement/prevention of neurological deficits are primary objectives of such procedures.<sup>11</sup>

The aim of this work is to evaluate the clinical and radiological outcome of the anterior surgical approach in the management of lesions of the thoracolumbar area.

## Patients & Methods

A total of 15 patients admitted and surgically treated for thoracolumbar spine lesions in the period through January 2007 to January 2011. All patients underwent anterior thoracolumbar fixation surgery. Data were analyzed retrospectively.

Patients were clinically and neurologically evaluated and categorized according ASIA impairment scale<sup>1</sup> (**Table 1**).

**Table 1.** ASIA Impairment Scale <sup>1</sup>

<b>A) Complete:</b> No motor or sensory function is preserved in the sacral segments S4-5.
<b>B) Incomplete:</b> Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
<b>C) Incomplete:</b> Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
<b>D) Incomplete:</b> Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
<b>E) Normal:</b> motor and sensory functions are normal

Routine laboratory workup was done to all patients including ESR, CRP, CBC, etc. Anterior posterior (AP) and lateral Plain Radiographs, Magnetic Resonance Imaging (MRI) and Computerized Tomography (CT) scan of thoracolumbar spine was carried out in all patients. The segmental kyphosis angle was measured on lateral radiographs as the angle between the superior endplate of the first uninvolved vertebra proximal to the affected segment and the first uninvolved vertebra distal to the affected segment. In patients with TB spondylitis, anti tuberculous treatment was started preoperatively after confirmation of diagnosis by positive culture or histologic results and continued for total of nine months.

### **Operative Technique:**

The affected vertebra was exposed by a left sided transthoracic intrapleural, retroperitoneal approach. The patient is placed in the true lateral position, with

sufficient axillary roll under the right armpit and the lesion level over the break of the table. The table is then flexed to open up the vertebral interspaces; left sided approach is preferred to avoid retraction of the liver and inferior vena cava. Exposure above and below the diaphragm is usually needed to obtain an adequate working area for decompression and placement of the instrumentation. In all cases an 11<sup>th</sup> rib exposure is used, and the bone is saved for later use as part of the autograft.

Ligating the segmental vessels exposes one vertebral level above and one vertebral level below the lesion. The neural foramen (and therefore the anterior wall of the canal) is identified to define the posterior extent of the corpectomy. The disc spaces are incised and a Cobb elevator is used to scrape the endplates. The disc material is then removed.

In fractures: with the neural foramen as a posterior landmark, the bulk of the vertebrectomy is

performed with an osteotome to preserve as much bone as possible for use as autograft. Along with the harvested rib, this quantity of bone has always been adequate to pack our cages fully and has obviated the need for harvesting iliac crest autograft. A high-speed drill is used to finish the corpectomy, drilling the bone to a thin layer of cortical bone ventral to the posterior longitudinal ligament, which is carefully removed by using the curette to push it ventrally into the corpectomy defect.

In TB spondylitis, adequate surgical debridement of pus, caseous material necrotic bone and sequestra was done.

The dura is always visualized from pedicle to pedicle, and epidural venous bleeding is controlled. The Z-plate device is placed, and distractive forces are applied to reduce the kyphotic deformity. An appropriate-sized titanium interbody cage is measured. It is then tightly packed with the corpectomy bone and rib and tapped gently into place, and care is taken to avoid impinging on the dural sac. The cage and bone graft are placed under compression by removing the flexion from the table and compressing across the Z-plate. The wound is then irrigated with third generation cephalosporin solution and closed in layers with a thoracostomy tube postoperatively. Corpectomy, iliac crest bone grafting & Z-plate fixation were done in 6 patients; corpectomy, titanium cage placement & Z-plate fixation was carried out in 9 patients.

All patients were fitted with a thoracolumbar orthosis for six months and were encouraged to ambulate within 7 days of surgery. Patients underwent physiotherapy postoperatively.

**Follow up:**

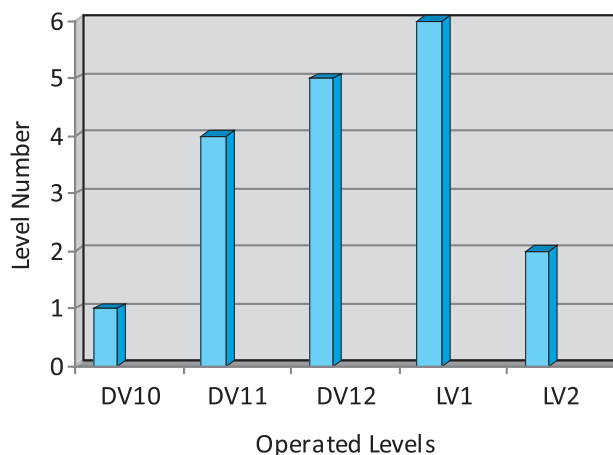
The outcome was evaluated with (ASIA) scale after three months, six months and one year following surgery. Plain x-Ray both anteroposterior and lateral views and 3D Computed Tomography were done postoperatively. The segmental kyphosis angle was measured on lateral radiographs of each visit. The presence of fusion was determined from two plain radiographs and was verified with CT scan. In TB spondylitis cases, Erythrocyte Sedimentation Rate (ESR) and C-Reactive Protein (CRP) were monitored regularly to exclude the presence of active process. Anti tuberculous treatment was discontinued after 9 months.

**Results**

Fifteen patients including 10 males and 5 females with age ranging between 17 and 70 years (mean 43.6, SD 12.8) were operated upon by anterior surgical approach. The diagnosis of traumatic fractures in 10 patients (7 patients had burst fractures and 3 patients had fracture-dislocation according to McAfee classification)<sup>10</sup> and TB spondylitis in five patients were reported. The indications for surgery were instability in traumatic fractures while in TB spondylitis the surgical indication was due to neurological deterioration in two patients, epidural abscess in two patients and progressive deformity in one patient.

In the fifteen patients, eighteen vertebral bodies were affected and dealt with by the anterior surgical procedure. The distribution of lesions is shown in figure 1.

**Figure 1.** Operated spinal levels in our study, N=15



According to the ASIA impairment scale; 5 patients were grade A, 2 patients were grade B, 3 patients were grade C, 3 patients were grade D and 2 patients were grade E preoperatively (Table 2).

**Table 2.** Preoperative and Postoperative ASIA Grades in the Study Patients

ASIA grade before operation	No of cases	ASIA grade after operation				
		A	B	C	D	E
A	5	5				
B	2		1	1		
C	3			1	2	
D	3					3
E	2					2

In spondylitis patients, antituberculous treatment was started preoperatively after confirmation of diagnosis by positive culture or histologic results (obtained by CT-guided biopsy). This treatment was discontinued after nine months.

The average operative time was 4 hours (range 3.5-7 hours). Corpectomy, iliac crest bone grafting & Z-plate fixation were done in 6 patients; corpectomy, titanium cage placement & Z-plate fixation was carried out in 9 patients (Figure 2). Three patients needed augmented posterior fixation by transpedicular screws in two patients and hooks in one (Figure 3). The average postoperative hospitalization was 14.5 days (range 10–21 days).

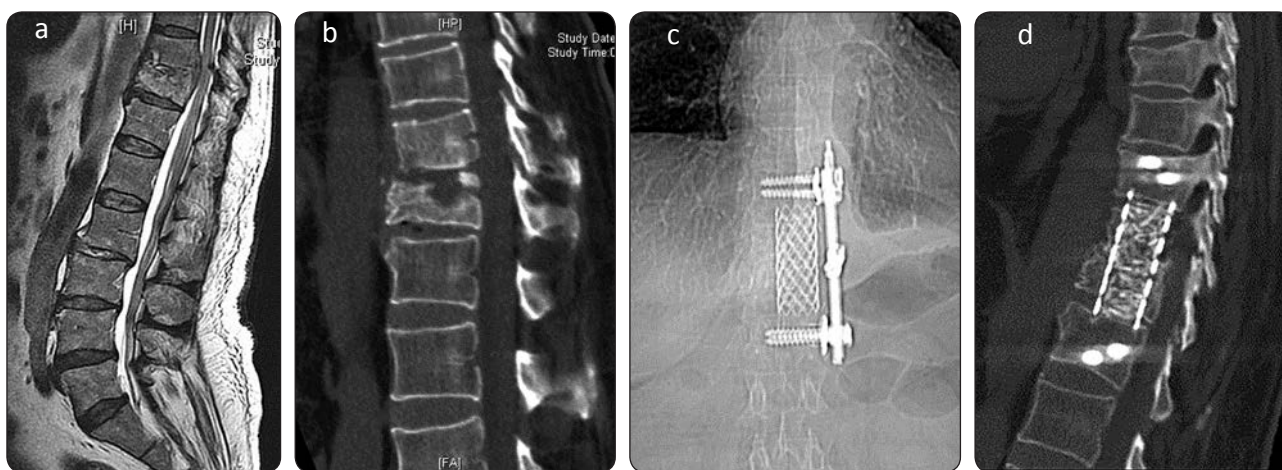
In all patients radiographic studies were performed at 3, 6 and 12 months follow up visits. ESR and CRP were done to monitor the active TB process and were reduced to normal limits within 6 months of starting treatment. The median follow up period was 9.5 months (8–12 months).

According to ASIA; patients grade A (N=5), and E

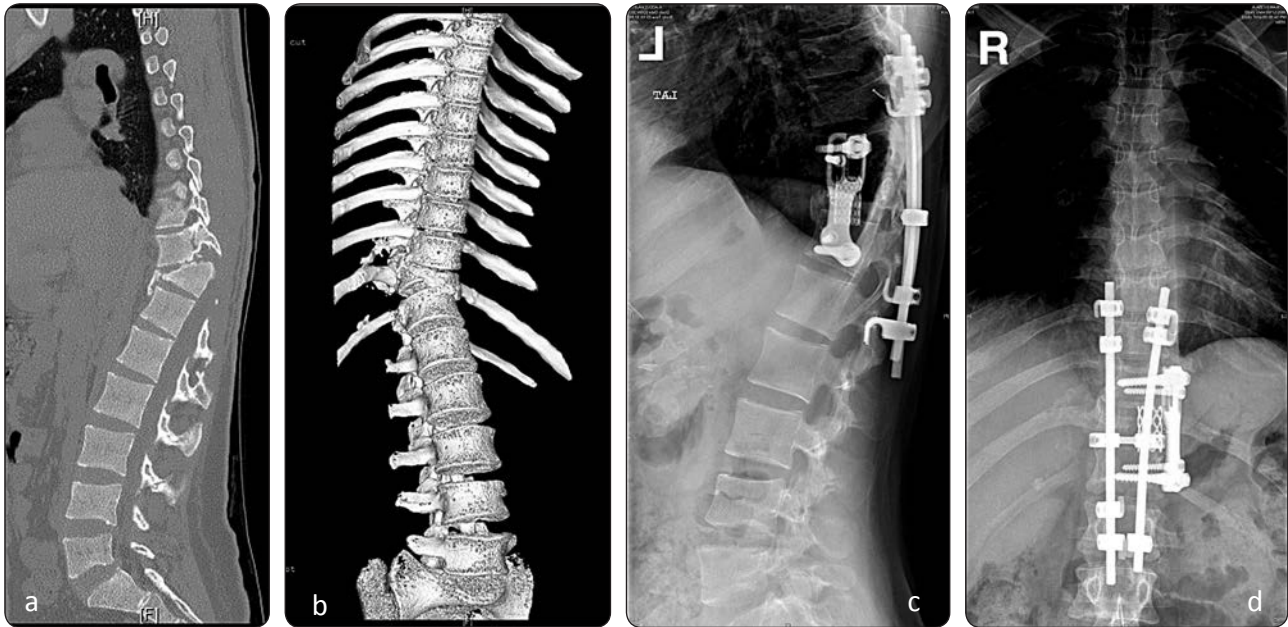
(N=2) remained the same post-operatively, whereas, of the other patients with incomplete cord lesion (N=8), six improved one grade and two did not improve at the last follow-up (Table 2).

The preoperative segmental kyphosis improved postoperatively (at the three month follow up visit) from a mean of 26.2° (range 16- 35°) to a mean of 11° (range 5- 17°). This correction was maintained in all but three patients who lost correction of a mean 3° (at the end of the follow up visits- at 12 months). There was lateral placement of screws in 2 patients. Revision surgery was not carried out, as the patients were stable over the next 6 months. None of the patients had implant failure. All patients had bone fusion on final follow up plain radiography.

Superficial wound infection occurred in two patients and improved later on with appropriate medical treatment. Pleural effusion occurred in two patients and was treated conservatively and hemothorax occurred in one patient treated with closed tube drainage.



**Figure 2.** A: Preoperative MRI of D11-12 TB spondylitis, B: Preoperative CT-scan (sagittal reformat) of D11-12 TB spondylitis, C: Postoperative plain X-ray (Anterior-posterior view) of the same patient, D: Postoperative CT-scan (sagittal reformat) of the same patient.



**Figure 3.** A: Preoperative CT-scan (sagittal reformat) of D11 fracture-dislocation, B: Preoperative 3D CT scan of D11 fracture- dislocation, C: Postoperative plain X-ray (Anterior-posterior view) of the same patient, D: Postoperative plain X-ray (Lateral view) of the same patient.

## Discussion

The use of the anterior surgical approach to the thoracolumbar spine, whether as the sole approach or as a part of combined approach has been advocated by many authors during the past 50 years.<sup>17</sup>

Initial reports of the anterior thoracotomy approach to the thoracic spine were related to Pott's disease. Nevertheless, with the advent of anti-tuberculous antibiotic therapy, a decline in the number of cases led to less need for this procedure.<sup>4</sup> In this series the surgical indication was due to neurological deterioration in two patients, epidural abscess in two patients and progressive deformity in one patient. Placement of instrumentation in an infected area and the increased risk of deep wound infection had resulted in the controversy of the two-stages surgery, debridement/bone grafting then delayed instrumentation, versus the debridement/ bone grafting and instrumentation at the same sitting.<sup>1</sup> In TB spondylitis in this series debridement/ bone grafting and instrumentation were done in the same sitting with no postoperative deep wound infection.

Fracture is the most common pathological event at the thoracolumbar junction. These fractures often result in a significant instability of the spine

and lead to acute or delayed neurological deficits. Most authors agree that unstable thoracolumbar fractures require surgical treatment, but which specific approach should be used for the treatment is still controversial.<sup>3</sup> Posterior approach surgery has the most acceptable perioperative parameters, which presents a great advantage if a surgical decompression is planned within first 8 hours after the fracture. However, anterior and combined front/back surgical approaches are still commonly employed.<sup>6</sup> There are major disadvantages for the posterior approach surgery. The first one is the usually insufficient indirect spinal canal clearance obtained by annulotaxis. The second is that partial or complete laminectomy can improve decompressions of the spinal canal but may destabilize the spine by increasing the spinal deformity. The third disadvantage is a frequent failure of pedicle screw fixation techniques, which happens even in cases in which a laminectomy has not been performed.<sup>6,15</sup>

The anterior approach minimizes damage to the posterior ligamentous structures of the spine. The primary indication for an anterior decompression is an incomplete neurologic deficit with marked canal compromise and intact posterior ligamentous complex.<sup>3</sup>

The anterior technique provides a direct and

therefore more predictable decompression of the ventral canal. Whether this improved decompression leads to an enhanced neurologic recovery rate depends more on the level (cord, conus, cauda equina) and the initial severity of the injury than on the estimate of the static canal compromise.<sup>10</sup>

Kostuik recommended the anterior technique after demonstrating an average recovery of 1.6 Frankel grades in his patient series. Other studies indicate that anterior decompression may also be more effective in restoring bladder function, with more than one third returning to normal.<sup>7</sup>

Anterior instrumentation is most effective when balanced by an intact posterior ligamentous tension bands. In recent years, several anterior fixation devices have been developed: anterior thoracolumbar locking plate (ATLP), Armstrong plate, ASIF T-plate, Dewald-LDI system, Dunn device, Kaneda device, Kostuik-Harrington device, Olerud plate, Slot-Zielke device, Synthes plate, Texas Scottish Rite Hospital device, University anterior plating system, and Yuan plate. The array of devices indicates the difficulty in designing an anterior fixation device that features low risk for vascular injuries, high neurologic recovery, low rates of hardware failures, high fusion rates, compatibility with computed tomography and magnetic resonance imaging, high rigidity, ease of insertion, and the option to perform a reduction of kyphotic deformity.<sup>14</sup>

The Z-plate has demonstrated adequate stability for most loading situations. The low profile of this system is intended to prevent vascular complications and allow easy repair of the diaphragm. As a dynamic device, it allows distraction and reduction of kyphotic deformity as well as the ability to compress after bone grafting. The radius of curvature of the plate allows the plate to be closely applied to the curvature of the vertebral body. The titanium materials are CT-scan and MRI compatible. Although the Z-plate was approved by the US Food and Drug Administration in 1993, few clinical studies have been conducted to evaluate its advantages and disadvantages.<sup>18</sup>

The use of titanium interbody fusion cages placed in the anterior column has been shown to be efficacious to span a single disc space and promote arthrodesis at that level.<sup>19,20</sup>

In a review of complications associated with the Kaneda device, McAfee has briefly reported on 10 patients with thoracolumbar burst fractures whose

vertebrectomies were reconstituted using carbon fiber cages packed with autologus bone.<sup>9</sup>

Titanium cages packed with autologus bone graft for vertebral reconstruction was used in 9 patients in this series. Titanium cage packed with autologus bone graft for vertebral reconstruction allows for safe and increased decompression of neural structures to promote maximal neurological recovery; provides immediate stability and allows for early mobilization that should reduce perioperative complications; involves a minimum number of motion segments, possibly minimizing current and subsequent back pain; corrects deformity and restores sagittal alignment, which may also reduce the incidence of low-back pain; has a minimal complication rate compared with other treatment options; and has results that compare favorably with all previous published reviews of management of thoracolumbar fractures.<sup>18,19</sup>

However the use of anterior approach for the treatment of thoracolumbar spine disease has several limitations a) the incidence rate of transient intercostal neuralgia and pulmonary complications, such as postoperative atelectasis, pneumothorax, pleural effusion, and hemothorax has been reported to be (14.1–29.4%).<sup>4,5,20</sup> However in this study the incidence was 13.3% for pneumothorax and 6.7 % for hemothorax.

## Conclusion

Anterolateral approaches can be an effective means of treating thoracolumbar spine lesions. It allows better safe decompression of neural structures. The titanium cage and Z-Plate system provide efficient stability and allows for early mobilization.

## References

1. American Spinal Cord Injury Association. Standards for neurological and functional classification of spinal cord injury, revised. Chicago, IL: American Spinal Cord Injury Association; 1992.
2. Christodoulou AG, Givissis P, Karartaglis D, Symeonidis PD, Pournaras J: Treatment of Tuberculous Spondylitis with Anterior Stabilization and Titanium Cage. *Clinical Orthopaedics and Related Research* 444:60-65, 2006

3. Dai LY, Jiang SD, Wang XY, Jiang LS: A review of the management of thoracolumbar burst fractures. *Surg Neurol* 67:221-31, 2007
4. Doria C, Zachos A, Muresu F, Tranquilli Leali P: The Corpectomy Using Minimally Invasive Access in Thoracolumbar Fractures. *Orthop Muscul Syst* 1:3, 2012
5. Hong JT, Lee SW, Son BC, Sung JH, Park CK, Kim MC: Kyphotic angle measurement accuracy for vertebral osteoporotic compression fracture: reliable method for kyphotic angle measurement. *J Korean Neurosurg Soc* 39:256-259, 2006
6. Kim HS, Lee SY, Nanda A: Comparison of Surgical Outcomes in Thoracolumbar Fractures Operated with Posterior Constructs Having Varying Fixation Length with Selective Anterior Fusion. *Yonsei Med J* 50(4):546-554, 2009
7. Kostuik JP: Anterior fixation for fractures of the thoracic and lumbar spine with or without neurological involvement. *Spine* 13(3):286-93, 1988
8. Lee YS, Kim YB, Park YS, Kim KP: Significance of Anterior Support in Thoracolumbar Burst Fracture: Single Stage Interbody Fusion with Transpedicular Screw Fixation Versus Pedicle Screw Fixation with Lamina Onlay Fusion. *Kor J Spine* 5(4):251-257, 2008
9. McAfee PC, Bohlman HH, Yuan HA: Anterior decompression of traumatic thoracolumbar fractures with incomplete neurological deficit using a retroperitoneal approach. *J Bone Joint Surg Am* 67:89-104, 1985
10. McAfee PC, Yuan HA, Fredrickson BE, Lubicky JP: The Value of Computed Tomography in Thoracolumbar Fractures: An Analysis of One Hundred Consecutive Cases and a New Classification. *J Bone Joint Surg* 65-A:461-473, 1983
11. Mohanty SP, Bhat NS, Abraham R, Keerthi CI: Neurological deficit and canal compromise in thoracolumbar and lumbar burst fractures *J Orthopaedic Surgery* 2008;16(1):20-3, 2008
12. Nadir A, Sahin E, Ozum U, Karadag O, Tezeren G, Kaptanoglu M: Thoracotomy in spine surgery. *Thorac Cardiovasc Surg* 56:482-84, 2008
13. Roque P, Feiz-Erfan I, LoVecchio F, Wu TS: Approach to Acute Thoracolumbar Spine Fracture Management in the Emergency Department, *Emergency Medicine Reports* 32(13)157-175, 2011
14. Sasso RC, Best NM, Reilly TM, McGuire RA Jr: Anterior-only stabilization of three-column thoracolumbar injuries. *J Spinal Disord Tech* 18(suppl):S7-S14, 2005
15. Snell BE, Nasr FF, Wolfla CE: Single-stage thoracolumbar vertebrectomy with circumferential reconstruction and arthrodesis: Surgical technique and results in 15 patients. *Neurosurg* 58:263-268, 2006
16. Swain A, Grundy D. Evacuation and initial management at hospital. In: *ABC of spinal cord injury: Fourth edition, 2002, Ch 2:5-11, BMJ Books*
17. Thopson JH, Chapman JR: The role of surgery in thoracolumbar trauma. *Current Opinion in Orthopaedics* 14:159-164, 2003
18. Uchida K, Kobayashi S, Matsuzaki M, Nakajima H, Shimada S, Yayama T, et al: Anterior versus posterior surgery for osteoporotic vertebral collapse with neurological deficit in the thoracolumbar spine. *Eur Spine J* 15:1759-1767, 2006
19. Üzümcügil O, Akman YE, Azar N, Yeti M: Surgical treatment of thoracolumbar spine fractures, relationship between radiological parameters and clinical results. *Turkish J Spine Surg* 20(2):63-68, 2009
20. Wang ST, Ma HL, Lu CL, Yu WK: Is fusion necessary for surgically treated burst fractures of the thoracolumbar and lumbar spine? A prospective, randomized study. *Spine* 31:2646-52, 2006

Address reprint  
request to:

**Moataz A. Elawady, MD.**

Email: moataz\_elawady@yahoo.com

Neurosurgery Department, Banha University, Banha, Egypt.

## الملخص العربي

التدخل الجراحي الأمامي لأعصاب المنطقة الفقارية الصدرية - القطنية: تقييم المردود السريري والتصويري بيانات أساسية: إن دواعي التدخل الجراحي الأمامي لأعصاب العمود الفقري تشمل كل ما يؤدي إلى تحطم أكثر من فقرة أو غضروفين من غضاريف ما بين الفقرات أو الكسور والتشوهات.

الغرض: أجريت هذه الدراسة لتقييم المردود السريري والتصويري للتدخل الجراحي الأمامي لأعصاب المنطقة الفقارية الصدرية - القطنية.

تصميم الدراسة: دراسة بأثر رجعي لحالات سريرية ومراجعة الأبحاث.

الطرق: في الفترة ما بين يناير ٢٠٠٧ ويناير ٢٠١١ تبين أن ١٥ مريضا قد اجري لهم تدخلا جراحيا أماميا بسبب عطب بالمنطقة الفقارية الصدرية-القطنية (عشرة يعانون من كسور وخمسة يعانون من التهابات بالعمود الفقري) وقد تم تتبع المرضى سريريا وتصويريا باستخدام الأشعة السينية والتصوير الطبقي متعدد المقاطع ثلاثي الأبعاد.

النتائج: اجري التدخل الجراحي الأمامي بسبب عطب بالمنطقة الفقارية الصدرية - القطنية في ١٥ مريضا (١٠ ذكور و ٥ إناث) وأثبتت التقارير الطبية تحسن الحالة السريرية لـ ٦ مرضي والثبات الفقاري الميكانيكي بكل الحالات.

الخلاصة: أثبتت الدراسة فعالية وأمان التدخل الجراحي الأمامي لأعصاب المنطقة الفقارية الصدرية - القطنية.