

# Wiltse Approach versus Conventional Open Approach in Neurologically Intact Patients with Thoracolumbar Fractures: Clinical and Radiological Outcome Study

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## Abstract

**Background Data:** Percutaneous screws fixation became popular as it depends on minimal muscle destruction and no para-spinal muscle stripping. However, there is a lot of disadvantages of percutaneous fixation technique including the high radiation exposure. Complications reported in conventional midline approach including muscle stripping from lamina and spinous processes and long-term postoperative pain and muscle weakness led the spine surgeon to rediscover minimally invasive technique to manage spinal fractures through posterior approach. One of these techniques is Wiltse technique which access the pedicle through blunt dissection between the longissimus muscle and multifidus muscle.

**Purpose:** This study aims to compare pedicle screw fixation via Wiltse approach, and the traditional posterior midline approach outcome.

**Study Design:** Prospective comparative study.

**Patients and Methods:** A total of 36 patients of single-level thoracolumbar fractures without neurologic injury underwent pedicle screw fixation using two different approaches. Twenty patients were treated using conventional technique (Group 1 ), and 16 patients were operated using Wiltse technique (Group 2 ). Screw placement accuracy rate, operative time, blood loss, postoperative hospitalization time, radiation exposure time, postoperative improvement of Cobb angle for regional kyphosis, functional disability index using Oswestry Disability Index, and Visual Analogue Scale (VAS) of the two groups were compared.

**Results:** There were no significant differences in the accuracy rate of pedicle screw placement, radiation exposure and Cobb angle improvement between the two groups. However, the Wiltse technique had obvious advantages over the conventional technique in operative time, blood loss, hospitalization time, ODI improvement and postoperative short-term improvement in VAS.

**Conclusion:** Our data suggest that pedicle screw insertion using Wiltse technique for treatment of thoracolumbar fracture has the advantages of less tissue trauma, short operative and rehabilitative time on the premise of guaranteed accuracy rate and no significant increased radiation exposure. (2018ESJ160)

**Keywords:** thoracolumbar fracture; pedicle screw; Mini-open; Wiltse technique; minimally invasive; paraspinal approach

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## Introduction

The thoracolumbar spine is most common area for spinal fractures. Management thoracolumbar fractures depending on a lot of clinical parameters; one of these clinical parameters is the neurological status. In patients with neurological deficit, internal fixation after decompression has been widely accepted. In neurologically intact patients the stability of the fracture, kyphotic deformity, collapse of the vertebral height, spinal canal compromise and integrity of the ligaments are the factors to be in mind and may change the management option from conservative to surgical one.<sup>6,16</sup>

Reinhold et al,<sup>20</sup> reported on a prospective multicenter study comparing operative versus non-operative treatment in patients of burst fracture types A3 of the thoracic and lumbar vertebral spine. Twelve of them were treated conservatively, 60 operatively. The period of return to work was twice as long in the patient group treated conservatively. The average gain of correction, which persisted for 15 months, was significantly better in the operatively treated patient group.

The conventional open posterior pedicle screw fixation with posterior midline incision is associated with detachment of the para-spinal muscles from the spinous process and lamina. This is the conventional, traditional old method but it seems to be destructive surgery associated with destruction of muscle, denervation and subsequent atrophy and weakness.<sup>10</sup>

In addition, this conventional technique may be disadvantaged by prolonged operative time, increased intraoperative bleeding and delayed functional rehabilitation.<sup>12</sup> The sequelae of back muscle destruction are facing and destructing the planned benefits of spinal surgery. Some authors reported back muscle atrophy and denervation as one of the causes of failed back syndrome.<sup>8</sup>

Percutaneous screws fixation became popular as it depends on minimal muscle destruction and no para-spinal muscle stripping. a lot of advantages were reported with percutaneous fixation technique including less bleeding, lower infection risk, lower incidence of postoperative pain, shorter rehabilitative time and reduced hospitalization

time.<sup>1</sup> however, there is a lot of disadvantages of percutaneous fixation technique including the need of specialized equipment, long learning curve,<sup>5</sup> high incidence of screw malposition<sup>21</sup> and large doses of radiation exposure.<sup>18</sup>

Due to these advantages and disadvantages found in both conventional approach and percutaneous technique, a midway technique has been rediscovered recently. The concept of Wiltse technique is to insert the pedicle screw the pedicle through mini open approach by dissecting between the multifidus muscle and longissimus muscle.<sup>5</sup> it has been used for a lot of pathologies including far disc herniation<sup>3</sup> and thoracolumbar fracture fixation.<sup>15</sup>

In this study, we are comparing the clinical, radiological outcomes by using Wiltse technique versus conventional technique in pedicle screws fixation as a management for neurologically intact patients suffering from thoracolumbar fractures.

## Patients and Methods

This study was designed to evaluate the clinical and radiological data of 36 neurologically intact patients with single level thoracolumbar fractures and operated by posterior spinal fixation techniques. Group (1) including twenty patients (12 males and 8 females) were operated using conventional technique and group (2) including sixteen patients (12 males and 4 females) were treated using pedicle screws via Wiltse technique. Inclusion criteria were; patients with single level thoracolumbar vertebral fractures classified as A1, A2, A3 or B1 type according to the AO classification, age from 18 to 65 years, had fresh fractures and treated surgically within 10 days after injury, TLICS score >4 and load-sharing score 7. Exclusion criteria were; patients with neurological injury, spinal anatomical variations or non-traumatic spinal deformity, surgical contraindications like coagulopathy, and osteoporosis, and those who refused to sign informed consent.

### Surgical Technique:

While the patient on prone position after sterilization of the patient's thoracolumbar area:

**The conventional technique** was performed by doing vertical midline skin incision at the targeted thoracolumbar area localized according to

preoperative fluoroscopy. The thoracolumbar fascia was opened vertically para-medially just lateral to supraspinous ligament preserving the supraspinous ligaments. The muscles of the back (erector spinae and multifidus muscles) were stripped from the spinous process and lamina till the inferior articular facet. Localization of the facet joint and its capsule were identified and preserved. The junction of the transverse process with the superior articular facet was localized and entry point was selected according to the anatomical landmarks and confirmed by the fluoroscopy.

**The Wiltse technique:** (Figure 3,4) was performed using the same vertical midline skin incision at the target area, then blunt dissection of subcutaneous tissue, the thoracolumbar fascia was opened 2 cm lateral to the supraspinous ligament. Preoperative localization of the cleavage line between longissimus and multifidus muscles on MRI axial cut can help to localize the distance between the midline and targeted cleavage, then blunt dissection between the longissimus thoracis muscle (found superficially and lateral) muscle and multifidus muscle (found deeper and medially) was done to reach the mammillary process of the lumbar vertebra. The insertion of the pedicle screws were done in same manner as conventional method under fluoroscopic guided images.

Closure of the wound was done in layers; approximation sutures were done in conventional technique then fascia is closed then subcutaneous layer and final skin. The wound was closed in the same manner in Wiltse technique but no need for muscle approximation.

#### **Perioperative Parameters:**

The following parameters was reported and compared between both groups including; intraoperative parameters (operative time, estimated blood loss, X –Ray exposure) and postoperative clinical parameters (visual analogue scale for back pain, Oswestry Disability Index for functional evaluation) and radiological evaluation (regional kyphotic angle using Cobb angle in Lateral radiographs, position of the screws in postoperative CT). Finally, postoperative hospital course; in form of postoperative drainage volume, hospital stay length and postoperative wound infection.

All continuous data were presented as mean standard deviation (SD) and all categorical data as percentages or numbers. Statistical analyses for comparisons between groups were performed using the unpaired Student`s t-test, X<sup>2</sup> test. P< 0.05 was considered statistically significant. Statistical analysis was done using SPSS20.0 (SPSS, Chicago, IL, USA).

## **Results**

The two groups showed no statistically significant difference between both groups regarding the age, and the male predominance was found in both groups. In group (1); the conventional technique, we inserted 120 screws and we found 5 screws of medial pedicle breach less than 3 mm and only 3 screws of medial breach more than 3 mm but no redo surgery was indicated. While in group (2) the Wiltse technique, we inserted 96 screws and we found 4 screws of mild medial pedicle breach (less than 3 mm) and 2 screws of mild lateral breach (less than 3 mm) and 2 patients of medial breach more than 3 mm but no neurological symptoms were found in these patients needed any redo surgery (Figure 2). Group (2) of Wiltse technique showed statistically significant difference (P<0.05) in some parameters including the operative time, blood loss, hospital stay, and post-operative wound drainage. These parameters were significantly less in the group (2) Wiltse technique. However, the total intraoperative X-ray exposure was significantly less in group 1 (P<0.05) (Table 1).

The short-term improvement of the VAS was much better in Wiltse technique (group1), the post-operative VAS before discharge was statistically significant (P<0.05) and much lower in group-2 (Table 2). While there was no statistically significant difference between two groups pre-operatively and at final follow up. Each group showed statistically significant improvement when we compared the preoperative VAS with post-operative VAS. As regard the function disability assessed in both groups using the ODI, we found that there is no statistically significant difference when we compared the ODI between both groups. However, there was statistically significant improvement of ODI when we compared the ODI preoperatively versus at final

follow up in each group. (Table 2)

We did not find statistically significant difference when we compared both groups regarding the regional kyphotic angle correction, but there was

significant improvement of the regional kyphosis correction when we compared the preoperative Cobb angle with the Cobb angle post operatively (Table 3).

**Table 1.** Sociodemographic, Operative and Post-Operative Parameters in Both Groups

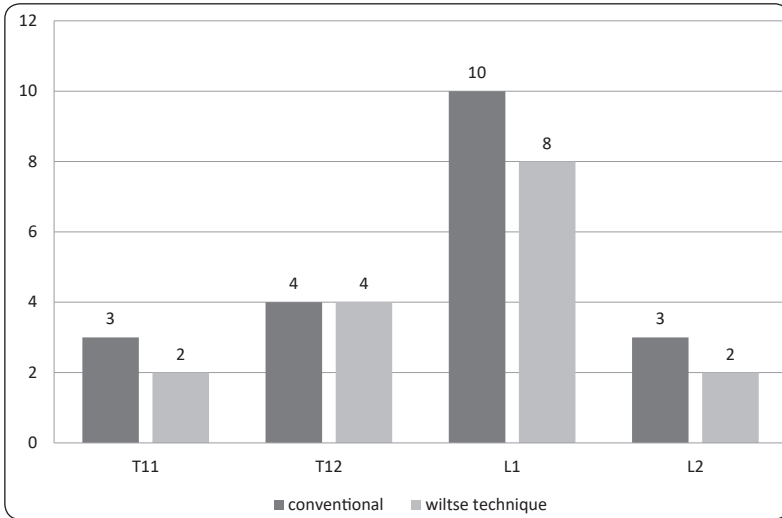
Parameters	Conventional technique Group-1 (N=20)	Wiltse technique Group-2 (N=16)	P value
Age	43.1512.3	41.114.39	P=0.648
Sex (male/female)	12/8	12/4	
Number of screws	120	96	
Total fluoroscopy time/sec	11.031.63	12.721.94	P<0.05
Operative time	101.7512.38	80.624.78	P<0.05
Operative blood loss	332.5100	162.550	P<0.05
Postoperative drainage	162.535.82	78.1330.1	P<0.05
Hospital stay/days	4.30.8	3.630.5	P<0.05

**Table 2.** Postoperative Improvement of VAS and ODI in both Groups

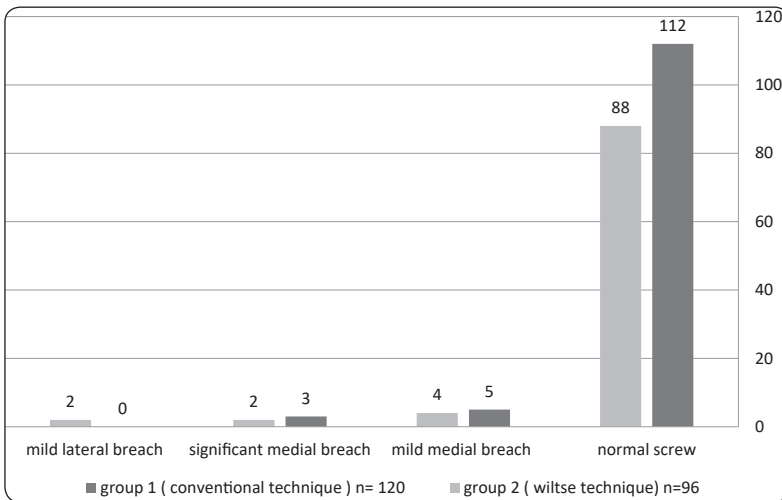
Parameters		Conventional technique Group -1 (N=20)	Wiltse technique Group -2 (N=16)	P value
VAS	Preoperative	7.250.85	7.311.01	0.848
	Postoperative (on discharge)	2.891.1	1.810.54	< 0.05
	Final follow up	0.80.62	0.810.66	0.963
	P value	P<0.05	P<0.05	
ODI	Preoperative	65.757.66	64.38	0.599
	Final follow up	4.8	15.63	0.693
	P value	< 0.05	< 0.05	

**Table 3.** Correction of Regional Kyphotic Angle in Both Groups

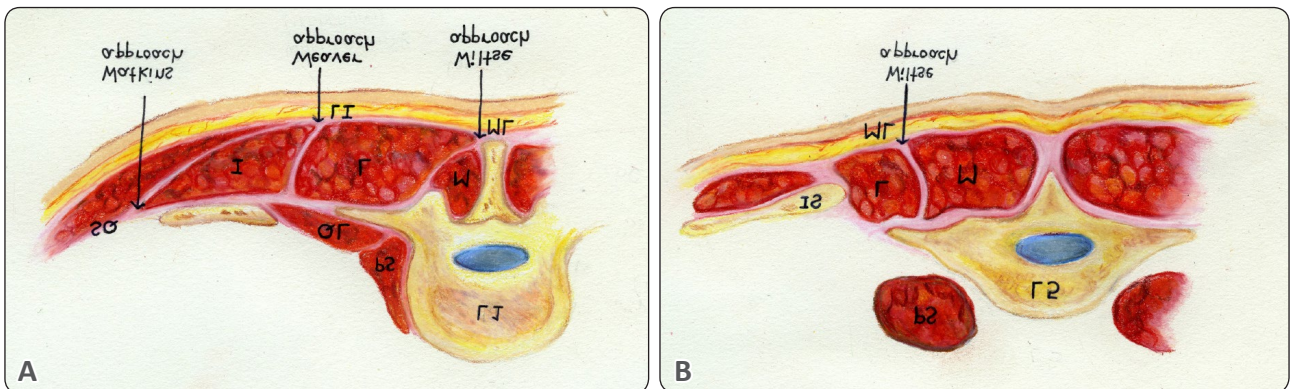
Cobb Angle	Conventional technique Group -1 (N=20)	Wiltse technique Group -2 (N=16)	P value
Preoperative	25.95.37	26.755.08	P=0.632
Postoperative	4.653.47	5.882.35	P=0.234
Final follow up	5.453.38	6.812.71	P=0.2
P value	P<0.05	P<0.05	



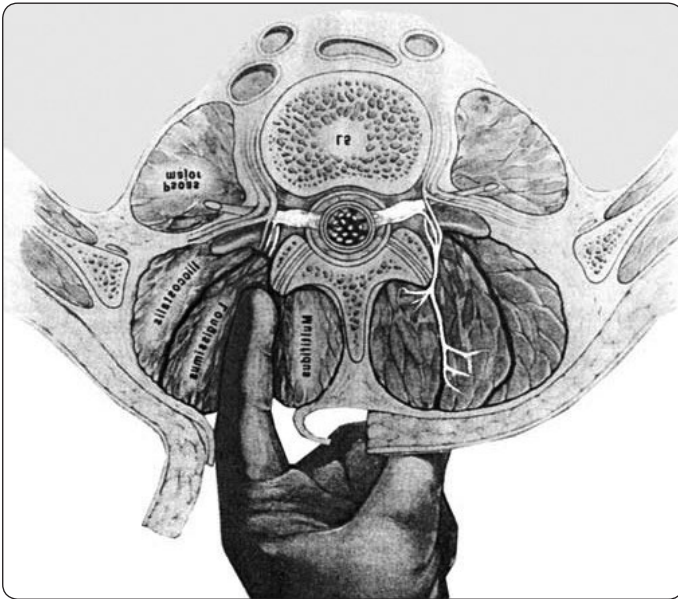
**Figure 1.** Distribution of level of fractured vertebra in both groups.



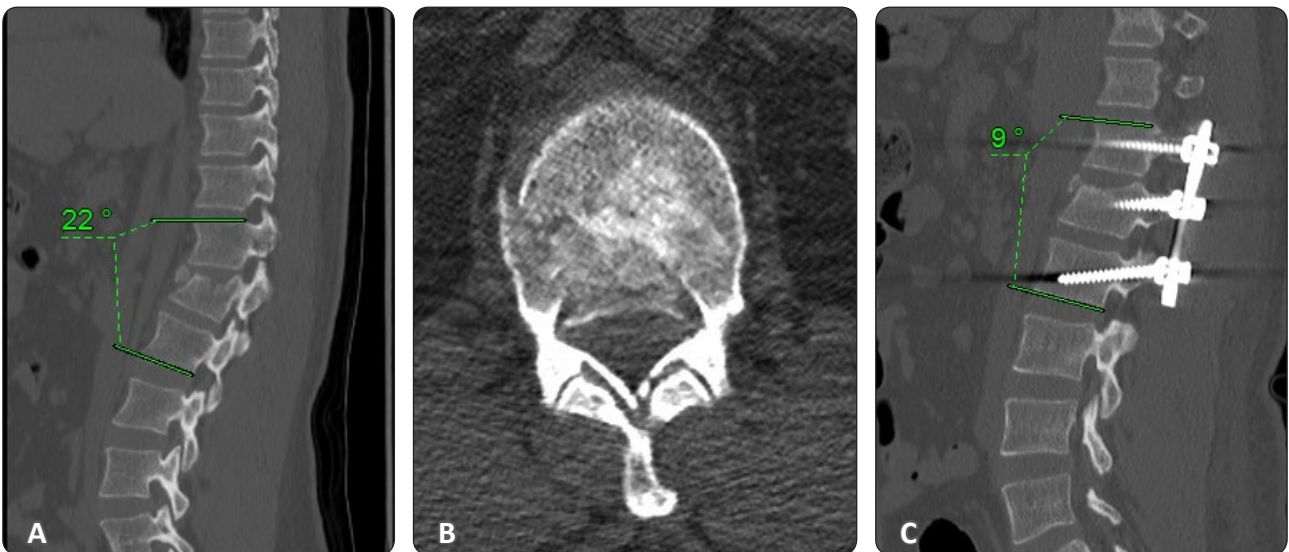
**Figure 2.** Evaluation of screws purchase in both techniques. (mild breach <3 mm, significant breach ≤3 mm)



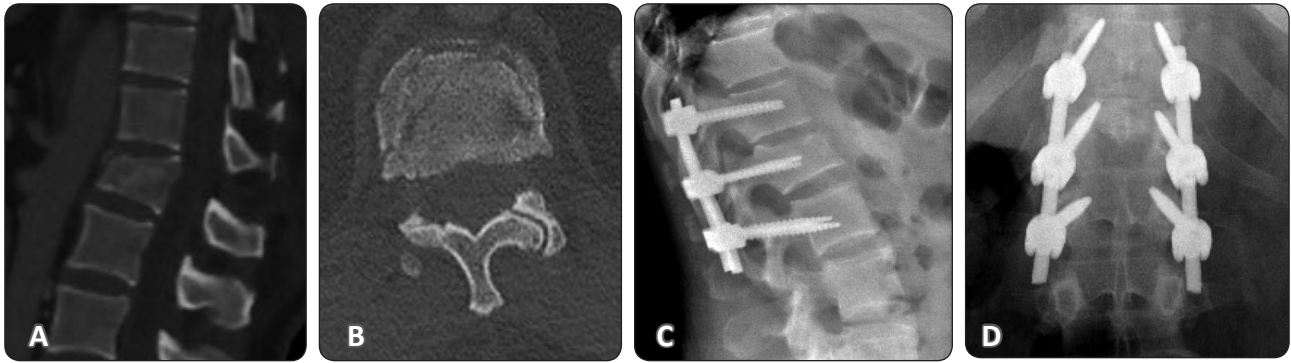
**Figure 3.** Axial anatomy is shown for the first (A) and fifth (B) lumbar vertebrae. The Wiltse, Weaver, and Watkins approaches are indicated. Abbreviations are as follows: M-multifidus, L-longissimus, I-Iliocostalis, PS- psoas major, QL- quadratus lumborum, ML-the division of multifidus and longissimus. It is apparent that the level of targeted cleavage between multifidus and longissimus muscle is varying according to the level. the cleavage line is near to midline in the upper lumbar vertebra and this cleavage line is far away from the midline in lower lumbar vertebra.<sup>25</sup>



**Figure 4.** The initial description by Wiltse of the paraspinous- splitting approach to the lumbar spine (1968)<sup>25</sup>



**Figure 5.** 45 years old male patient presented with type A3 of L1 due to fall from height operated through mini-open Wiltse approach. a) sagittal reconstruction of CT thoracolumbar spine showed regional kyphotic angle 22 degrees b) showed CT lumbar spine axial cuts of L1 vertebra. c) post-operative CT thoracolumbar spine showed correction of regional kyphotic angle post operatively to be 9 degrees



**Figure 6.** 42 years old male patient presented with fracture T 12 after road traffic accident. the patient was operated through midline short segment fixation. pain improvement and restoration normal daily life activity were reported at final follow up.(A,B) showed the preoperative CT of the affected vertebra and figure (C,D) showed post-operative lumbosacral radiograph AP & Lateral view showing normal alignment and accepted screws positions

## Discussion

Internal fixation using pedicle screws is considered the gold standard treatment of thoracolumbar fractures with satisfactory clinical and radiological outcomes. However, the conventional technique of posterior fixation is associated with significant muscle damage and high postoperative approach-related morbidity.<sup>13</sup> The conventional technique requires extensive paravertebral muscle dissection and retraction which leads to muscle denervation, atrophy and eventually muscle dysfunction. Furthermore, the wide exposure is associated with greater amount of intra/postoperative blood loss plus the potential risk of infection and significant postsurgical scarring. These drawbacks could affect the dynamically stable structures of the spine, compromise the strength of the trunk muscles, and provoke chronic back pain and functional impairments.<sup>19,24</sup>

In 1968, Wiltse et al,<sup>25</sup> performed blunt dissection and splitting of the natural gaps existing between the paraspinal muscles (multifidus and longissimus) to reach the facet processes and to perform pedicle screw fixation effectively with lesser trauma than that observed with traditional approach. Later, this technique has been used for the surgical treatment of thoracolumbar fractures in many studies.<sup>11,15</sup>

Our results demonstrated that patients treated using Wiltse technique have exhibited better parameters in terms of operative time, intraoperative bleeding, soft tissue damage and

postoperative hospital course. These patients could ambulate and perform postoperative exercises early, which shortened the hospitalization time and reduced the postoperative back pain when compared to those treated with the traditional open approach. The paraspinal muscles dissection was limited in the Wiltse technique group and resulted in smaller operative field with less obvious anatomical landmarks when compared with the open method where exposure of pedicle screw entry point is based on clear anatomical landmarks. However, the operative time was longer with the open method which could be explained by the longer time consumed in soft tissue dissection if compared to the rapid localization of the entry point under fluoroscopy in Wiltse technique group. But this resulted in longer time of radiation exposure in Wiltse technique group relative to the conventional group ((11.03 sec in conventional group Vs 12.72 sec in Wiltse technique group).

In the current study, we performed short segment fixation with intermediate screws into the fractured level without fusion in both groups as it was not suitable to perform fusion in the Wiltse group. Many previous studies<sup>4,17,23</sup> have demonstrated better outcome parameters in fractures with temporary bone instability and high potential of healing after immobilization as it provides pain relief, corrects the deformation and avoids any additional displacements. However, other studies<sup>2</sup> suggested that pedicle fixation with fusion seems better for fractures with significant wedging or

highly comminuted fractures.

Short segment fixation using 4 pedicle screws has been considered the mainstay treatment of thoracolumbar fractures with the advantages of preservation of the spinal motor functions and a relatively better postoperative morbidity. However, some reports<sup>7</sup> declared that the 4 pedicle screws method is associated with a high incidence of instrumentation failure in the form of screw/rod breakage, screw loosening, parallelogram effect (lateral instability) and late reduction loss. To overcome these shortcomings, some authors<sup>14</sup> have advocated using 6 pedicle screws fixation construct including the fractured level, and the results showed marked reduction of the above-mentioned complications. This method shortens the distance between the screws and redistributes the anteromedial column load which can effectively reduce the stress concentrated on the screw-rod system, thereby improving the vertebral stability (axial loading capacity, anti-bending and anti-torsion characteristics) and decrease the rate of recurrent vertebral collapse.<sup>22</sup>

Early at time of discharge from hospital, the average VAS score for back pain was better in the group 2 (VAS=1.8) when compared to the pain scores of the open approach group (VAS=2.8). At final follow-up, both groups showed good pain control (VAS=0.8) when compared to the final pain scores following short segment fixation alone (VAS=3.4) in a clinical case series comprised 35 patients.<sup>9</sup>

Our results demonstrated satisfactory improvement of the mean Cobb angle in both groups, with non-significant loss of kyphosis correction between the early postoperative and the final follow-up radiographs. This support the usefulness of adding intermediate screws into the fractured level in minimizing the reduction loss and other hardware related complications.

The present study is limited by several constraints. Firstly, due to the small population size, there may be inadequate statistical power to accurately assess the efficacy and complication rates of the Wiltse technique. Therefore, the results presented in this study may not be applicable across a general population. Secondly, there are no long term follow

up radiologically and clinically the last follow up not more than 12 months the majority of patients( 30 patients) was followed for 3 months preoperatively. Thirdly, the clinical and radiologic outcomes were evaluated by the authors, which could bias interpretation of the findings. Radiation exposure also could represent a limitation.

## Conclusion

Our data suggest that pedicle screw insertion using Wiltse technique for treatment of thoracolumbar fracture has the advantages of less tissue trauma, short operative and rehabilitative time on the premise of guaranteed accuracy rate and no significant increased radiation exposure.

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The authors report no conflict of interest

## الملخص العربي

**التدخل المحدود على طريقة ولتز بالمقارنة مع النهج المفتوح التقليدي في علاج المرضى المصابين بكسور الفقرات الصدرية القطنية والذين لا يعانون من أي قصور عصبي: دراسة النتائج السريرية والإشعاعية.**

**البيانات الخلفية:** تعتبر طريقة العالم ولتز أحد طرق التدخل المحدود لتثبيت الفقرات القطنية من الخلف وذلك عن طريق الدخول للجزء الخلفي للفقرة عن طريق المنطقة الفاصلة ما بين العضلة عديدة الفلوح والعضلة الطويلة بالظهر. بدون الحاجة لكي العضلات او ابعادها عن الصفيحة الفقرية والذي قد ينتج عنه ضمور بعضلات الظهر والام مزمنة بالظهر ما بعد الجراحة.

**الغرض:** مقارنة بين طريقة ولتز لتثبيت الفقرات الصدرية والقطنية مقارنة باستخدام الطريقة التقليدية لتثبيت من الخلف في علاج كسور الفقرات بالمنطقة الانتقالية الصدرية القطنية

**تصميم الدراسة:** دراسة مقارنة محتملة

**المرضى و الطرق:** تم تقييم 36 مريض اجري لهم نوعين من الجراحات لعلاج كسر بأحد الفقرات بمنطقة الانتقالية للفقرات الصدرية القطنية وكان جميع المرضى لا يعانون من أي قصور عصبي. حيث تم استخدام طريقة ولتز ل 16 مريض بينما استخدم النهج التقليدي في 20 مريض والذي يستدعي فصل عضلات الظهر من الصفيحة الفقرية من المنتصف. تم تسجيل الملاحظات اثناء الجراحة وكذلك تقييم المجموعتين اكلينيكيًا وكذا نتائج اشعات المرضى ما بعد الجراحة

**النتائج:** في المجموعة الأولى حيث تم استخدام النهج التقليدي تم تركيب 120 مسمار بالفقرات الصدرية والقطنية بينما تم تركيب 96 مسمار عن طريق التدخل المحدود (طريقة العالم ولتز). وجد ان مجموعة المرضى الذين أجريت لهم الجراحة بطريقة ولتز قد أظهروا نتائج تشير الى ان وقت الجراحة وفترة البقاء بالمستشفى والدم المفقود اثناء الجراحة كان اقل بالمقارنة بالمجموعة الأخرى بينما أظهرت المجموعة الأخرى احتياج اقل للتصوير الاشعاعي داخل الجراحة. إكلينيكيًا كان تحسن الألم ما بعد الجراحة اقل في مجموعة التدخل المحدود بينما لم نلاحظ فارق بين المجموعتين في الالام والتحسن الوظيفي للمرضى على مقياس اوسويستري على المدى البعيد ما بعد الجراحة. وبتقييم نتائج الاشعات ما بعد الجراحة لم نلاحظ اختلاف في مقدار تحسن زاوية الحداب ما بعد الجراحة ما بين المجموعتين.

**الاستنتاج:** ان استخدام طريقة ولتز للوصول للفقرات لإجراء تثبيت للفقرات القطنية والصدرية هي طريقة وفعالة وأمنة. وينصح بها لتقليل وقت الجراحة والدم المفقود وتقليل الألم بعد الجراحة وكذلك تقليل فترة بقاء المريض بالمستشفى بعد الجراحة.