Comparative study between Wiltse approach and conventional posterior open approach in patients with lumbar fractures without neurological injury

Moataz A.E.Z. Elsabroot, Khaled M. Hassan, Essam M.A.E. El Morshedy, Mahmoud A.R.S. Elattar

Department of Orthopedic Surgery and Traumatology, Faculty of Medicine, Assiut University, Assiut, Egypt

Correspondence to Mahmoud A.R.S. Elattar, MSC, Department of Orthopedic Surgery and Traumatology, Faculty of Medicine, Assiut University, Assiut, Egypt.
Zip Code 71111;
Tel: +20 101 491 9050;
e-mail: midoelattar2018@gmail.com

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Background and aim
Thoracolumbar traumatic fractures are common in clinical practice. It is mainly treated with internal fixation, but the technique has many drawbacks. The Wiltse approach can manage these fractures with little drawbacks. This study was designed to compare the outcome of both Wiltse and conventional posterior approaches.

Patients and methods
A total of 30 neurological deficit-free patients of thoracolumbar fractures were enrolled in a prospective study between May 2017 and May 2018. Those patients were divided into equal groups based on the type of approach used for fixation; group I patients were treated using the conventional technique and group II were operated using the Wiltse technique. Baseline data, operative time, blood loss, degree of Cobb's angle, functional evaluation with the Oswestry disability index, pain assessment with visual analog scale, and muscle degeneration were compared in both groups.

Results
Both groups had insignificant differences as regards age and sex. There was male predominance in both groups. Blood loss was significantly more in the conventional posterior approach (372.66 ± 82.58) compared with that of the Wiltse approach (214.66 ± 55.01 ml). Cobb's angle in both conventional and Wiltse groups improved from (16.46 ± 4.25 and 19.40 ± 4.28) preoperatively to (8.13 ± 1.68 and 9.40 ± 3.42) postoperatively, respectively. There was no significant loss of correction in both groups comparing early and late follow-up. Visual analog scale score of low back pain was significantly better with the Wiltse approach (4.89 ± 0.98) than that of the conventional one (6.43 ± 1.11) at the time of discharge. The degree of muscle degeneration and fatty infiltration measured by MRI was more frequent with the conventional approach.

Conclusion
Management of thoracolumbar fracture with the Wiltse technique has the advantages of less tissue trauma.

Keywords:
thoracolumbar fracture, pedicle screw, Wiltse technique, paraspinal approach

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Introduction

There are different kinds of approaches to manage thoracolumbar traumatic fractures. It is mainly treated with internal fixation either through posterior, anterior, or paraspinal approaches. The posterior approach is still the most frequently used one [1].

Yet, this approach had many drawbacks as first, ischemia of paraspinal with subsequent necrosis and denervation secondary to muscle detachment; second, some patients complain of back pain, mainly low back pain (LBP); and third, it may be associated with spine instability due to damage of the posterior columns [2]. Explanation of the underlying cause of LBP in such procedure is attributed to demonstrated muscle denervation and [3].

Approach for management of lumbar spine fracture known as the paraspinal sacrospinalis-splitting approach was introduced in 1968 and is known as the Wiltse approach. In 1984, the use of percutaneous pedicle screw fixation in the lumbar spine was reported [4].

Globally, percutaneous pedicle screw fixation and Wiltse approach with pedicle screw fixation are widely used with many benefits as first, decreased intraoperative loss of blood; second, decreased hospital

stay; and third, less damage to paraspinal muscles. This will be associated with low incidence of LBP secondary to avoidance of muscle damage [5].

There are many limitations to percutaneous fixation technique as first, specialized equipment are required; second, difficult procedure that requires long time of experience and learning curve; third, risk of screw malposition; and fourth, exposure to high doses of radiation [5].

Use of the Wiltse approach in thoracolumbar fractures preserves the physiological curvature of the spine, reconstruct vertebral body height, reset the fracture blocks, with achievement of three-dimensional fixation. It has been widely used in the management of such fractures due to simplicity with favorable outcomes [6].

This study was designed to evaluate the radiological, clinical, and functional outcomes of Wiltse approach compared with the conventional posterior approach in the treatment of lumbar spine fractures without neurological injury.

Patients and methods

After obtaining the approval from the Local ethics Committee of our institute, the study was prospectively conducted in the period between May 2017 and May 2018 at the level one trauma center.

Patients

Thirty consecutive patients with single-level isolated lumbar spine fractures without neurological manifestations were included in this study. All patients were adults between 18 and 65 years old. Patients with fractures were classified as AO A1, A2, A3, A4, or B1. Patients with any of the following was excluded: age less than 18 years or more than 65 years, pathological or old fracture (>10 days of trauma), polytrauma, or OA class B2-3 or C.

Those patients were randomly divided into two groups, each group had 15 patients: Group 1 in which fixation was performed by the conventional posterior approach and group 2 where fixation was done by the Wiltse paraspinal muscle-sparing approach.

Methods

Preoperative evaluation

Full general and local examination was performed. Back pain was evaluated based on the visual analog scale (VAS). Patients were evaluated functionally based on the Oswestry disability index (ODI). Radiological evaluation included plain radiograph and computed tomography.

Anteroposterior plain radiograph was used to assess changes in coronal alignment, interpedicular distance and space between spinous processes, and lateral views to measure Cobb's angle, which is the angle between the vertical lines to the upper end plate of the upper adjacent vertebral body and lower end plate of the lower adjacent vertebral body [7].

Surgical techniques

Conventional technique

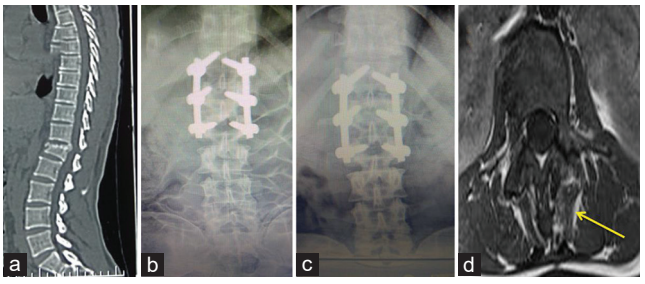
It was performed in prone position. Based on fluoroscopy, a vertical midline incision at the targeted area was done, By opening the thoracolumbar fascia vertically just lateral to the supraspinous ligament (Fig. 1).

Detachment muscle of the back from the spinous process and lamina till the inferior articular facet was performed and by preservation of the facet joint and its capsule. Junction of the superior articular facet with the transverse process was also localized. Selection of the entry point was done based on anatomical landmarks and fluoroscopy.

Wiltse technique

A vertical midline incision was done as in the conventional approach with blunt dissection of the subcutaneous tissue. Two centimeters lateral to supraspinous ligament, the thoracolumbar fascia was opened. Then blunt dissection was performed between the longissimus thoracic and multifidus muscles till the mammillary process of the lumbar vertebra. Entry point was selected as in the conventional approach (Fig. 2).

Figure 1



A 20-year-old male patient presented with fracture at L1 operated through the conventional approach: (a) sagittal reconstruction of computed tomography thoracolumbar spine, (b) raiograph of the lumbar spine (anteroposterior view) at discharge, (c) radiograph of the lumbar spine (anteroposterior view) at 6-month follow up, (d) axial T1-MRI at 6-month follow-up showed fatty infiltration (yellow arrow), and (e) intraoperative image after fixation.

Postoperative evaluation

Immediate postoperative evaluation was done, and also on discharge. Patients were followed up at 3 and 6 months later on. Patients were clinically assessed to exclude neurological complications, while VAS was used to assess pain. Creatinine phosphokinase was done within 3 days postoperatively to evaluate the degree of muscle degeneration. Functional assessment was done at 3 and 6 months later based on ODI.

To confirm secured right position of screws and to assess the degree of Cobb's angle, lateral and anteroposterior views of plain radiograph were done immediately postoperatively, at 3 months and 6 months. At 6 months of follow-up, magnetic resonance imaging (MRI) was done to detect muscle degeneration and fatty infiltration.

Based on the MRI, muscle degeneration may be type 1 in the form of edema or type 2 in the form of fatty infiltration. Fatty infiltration had three grades: first, less than 20% of cross-sectional area (CSA) containing fat; second, 20–50% of CSA containing fat; and third, greater than 50% of CSA containing fat. Type 3 of muscle degeneration is known as muscle scarring; these grades were assessed by an expert radiologist [8].

Statistical analysis

Data were collected and analyzed using SPSS (the Statistical Package for the Social Sciences, version 20; IBM, Armonk, New York, USA). Continuous data were expressed in the form of mean ± SD or median (range), while nominal data was expressed in the form of frequency (percentage).

χ^2-test was used to compare the nominal data of different groups in the study, while Student's *t*-test and paired *t*-test were used in the case of continuous data of both groups. *P* value was considered significant if less than 0.05. The level of confidence was kept at 95%; hence, a *P* value less than 0.05 indicated a significant association.

Results

Demographic data and the level of fracture in the studied patients

Both groups had insignificant differences as regards age, sex, and the level of fracture. The majority of patients in both groups were men. In the conventional approach group, the most frequently injured level was L3 (40%), followed by L1 (33.3%) and L2 (20%) and the least one was L4 (6.7%). In the Wiltse approach group, the most frequently injured level was L2 (46.7%), followed by L1 (40%), and the least one was L3 and L4 (6.7%) (Table 1).

Operative data, hospital stay, and creatinine phosphokinase in the studied groups

Blood loss was significantly more in the conventional approach (372.66 ± 82.58) compared with that of the Wiltse approach (214.66 ± 55.01 ml) with *P* value less than 0.001, while operative time and hospital stay in both groups had insignificant differences. CPK was significantly more in the conventional approach (1239.66 ± 345.11) compared with the Wiltse approach (481.13 ± 125.58 IU) with *P* value less than 0.001 (Table 2).

Radiological data of the studied groups

Cobb's angle in both conventional and Wiltse groups improved from 16.46 ± 4.25 and 19.40 ± 4.28 preoperatively to 8.13 ± 1.68 and 9.40 ± 3.42 postoperatively in order with no significant difference between the two groups. At last follow-up, both groups showed insignificant loss of Cobb's angle (Table 3).

In the conventional approach, one (6.7%) patient had muscle edema, 12 (80%) patients had fatty infiltration, and two (13.3%) patients had muscle scarring. In the Wiltse approach, it was noticed that 11 (73.3%) patients had muscle edema, three (20%) patients had fatty infiltration, and one (6.7%) patient had muscle scarring. As regards fatty infiltration, the three patients with fatty degeneration in the Wiltse approach were

Table 1cAge, sex, and level of fracture in the studied groups

	Conventional approach (*n*=15) [*n* (%)]	Wiltse approach (*n*=15) [*n* (%)]	*P*
Age (years)	29.86±19.28	38.66±14.18	0.15
Sex			0.53
Male	10 (66.7)	12 (80)	
Female	5 (33.3)	3 (20)	
Level of fracture			0.15
L1	5 (33.3)	6 (40)	
L2	3 (20)	7 (46.7)	
L3	6 (40)	1 (6.7)	
L4	1 (6.7)	1 (6.7)	

Data expressed as mean (SD), frequency (percentage). *P* value was significant if <0.05.

Table 2 Operative data, hospital stay, and creatinine phosphokinase in the studied groups

	Conventional approach (*n*=15)	Wiltse approach (*n*=15)	*P*
Operative time (min)	72.33±11.78	65.66±10.15	0.11
Blood loss (ml)	372.66±82.58	214.66±55.01	<0.001
CPK (IU)	1239.66±345.11	481.13±125.58	<0.001
Hospital stay (days)	2.46±0.52	2.13±0.35	0.34

Data were expressed as mean (SD). *P* value was significant if <0.05.

of grade 0, while in the conventional approach, fatty infiltration was of grade I in seven patients and grade II in five patients.

Clinical and functional outcomes in the studied groups

VAS score of LBP was significantly better with the Wiltse approach (4.89 ± 0.98 vs 6.43 ± 1.11; $P = 0.03$) than that of the conventional one at discharge from the hospital. At the last follow-up, both groups showed significant improvement in VAS compared with the preoperative one with no significant difference between the two groups (Table 4, Figs. 3 and 4).

The ODI of both groups significantly improved at the third and sixth month follow-up compared with the preoperative one. At the third month follow-up, the ODI was significantly better in the Wiltse approach (25.20 ± 6.65 vs 30.40 ± 7.61; $P = 0.01$) than that of the conventional one, but there was no significant difference between both groups at the 6-month follow up.

Table 3 Radiological data of the studied groups

	Conventional approach (n=15)	Wiltse approach (n=15)	P_1
Cobb's angle			
Preoperative	16.46±4.25	19.40±4.28	0.07
At discharge	8.13±1.68	9.40±3.42	0.63
At 6-month follow-up	9.13±1.99	10.60±3.35	0.52
P_2	<0.001	<0.001	
P_3	<0.001	<0.001	
MRI evaluation			< 0.001
Edema	1 (6.7)	11 (73.3)	
Fatty degeneration	12 (80)	3 (20)	
Grade 0	0	3 (20)	
Grade I	7 (46.7)	0	
Grade II	5 (33.3)	0	
Muscle scarring	2 (13.3)	1 (6.7)	

Data were expressed as mean±SD and n (%). P_1, compared between both groups but P_2 compared the same group at discharge and preoperative, P_3 compared the same group between preoperative and last follow-up. P value was significant if <0.05.

Table 4 Oswestry disability index and visual analog score in both groups

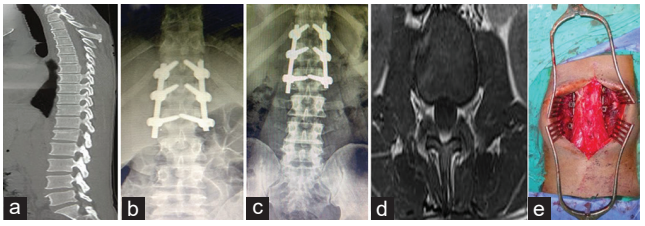
	Conventional approach (n=15)	Wiltse approach (n=15)	P_1
Visual analog score			
Preoperative	7.46±1.18	8.26±1.89	0.87
At discharge	6.43±1.11	4.89±0.98	0.03
6-month follow-up	2.11±0.75	2.26±0.59	0.43
P_2	0.01	0.01	
P_3	0.04	0.01	
Oswestry disability index			
Preoperative	74.06±10.38	73.01±5.93	0.76
3-month follow-up	30.40±7.61	25.20±6.65	0.01
6-month follow-up	15.90±3.67	13.45±1.45	0.09
P_2	0.02	0.01	

Data was expressed in the form of mean±SD. P_1, compared between both groups but P_2 compared the same group at 6 months postoperatively, P_3 compared the same group preoperatively and at discharge. P value was significant if <0.05.

Discussion

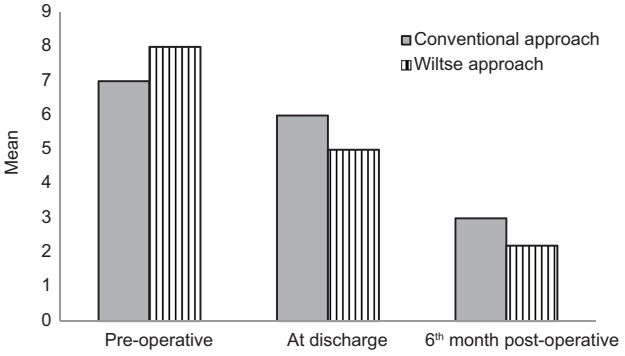
Fixation of the thoracolumbar spine fractures using pedicle screws is considered by far as a standard treatment approach with favorable outcome.

Figure 2



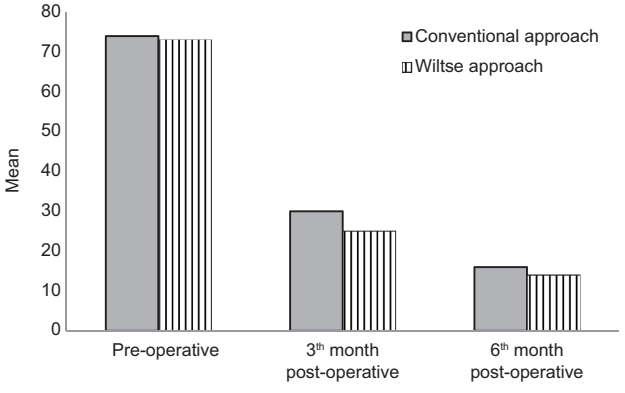
A 33-year-old male patient presented with fracture at L1 operated through mini-open Wiltse approach:(a) sagittal reconstruction of computed tomography thoracolumbar spine, (b) radiograph of the lumbar spine (anteroposterior view) at discharge, (c) radiograph of the lumbar spine (anteroposterior view) at 6-month follow-up, (d) axial T1-MRI at 6-month follow-up showed muscle edema, and (e) intraoperative image after fixation.

Figure 3



Visual analog score.

Figure 4



The Oswestry disability index.

Conventional open posterior pedicle screw fixation with posterior midline incision is associated with detachment of the paraspinal muscles from the spinous process and the lamina. It seems to be associated with destruction and denervation and subsequent weakness of the back muscles [9].

In addition, this conventional technique may be disadvantaged by prolonged operative time, increased intraoperative bleeding, and delayed functional rehabilitation. The sequelae of back muscle destruction are facing and destructing the planned benefits of spinal surgery. Some authors have reported back muscle atrophy and denervation as one of the causes of failed back syndrome [10].

Percutaneous screw fixation became popular where it is associated with minimal muscle destruction, less bleeding, lower infection risk, lower incidence of postoperative pain, shorter rehabilitative time, and reduced hospitalization time but it needs specialized equipment and a long learning curve.

There were high incidence of screw malposition and large doses of radiation exposure [11].

Midway technique (the Wiltse approach) has been reapplied recently. The pedicle screws are inserted by dissecting between the multifidus and longissimus muscles [8]. This study compared the outcomes of Wiltse approach with that of the conventional posterior approach in the treatment of lumbar spine fractures without neurological deficits.

This study showed no significant differences between both groups as regards age. In both approaches the majority of patients were men with no significant difference between both.

This study, there was no significant difference regarding operative time between the Wiltse approach and the conventional posterior approach. A different result was reported by Jiang and colleagues, who reported that the operative time was significantly lower in the Wiltse approach than the conventional approach.

In this study, the estimated blood loss in the Wiltse approach was significantly lower than that encountered in the conventional technique. Similar results were reported by Jiang and colleagues and Li and colleagues. It could be explained by minimal muscle destruction and no paraspinal muscle stripping [7,12].

Our results demonstrated satisfactory improvement of Cobb's angle in both groups with nonsignificant loss of kyphosis correction in the early postoperative and final follow-up radiograph, without significant difference between the two groups. Jiang and colleagues have reported comparable result in their study. This may be attributed to the similar universal technique of transpedicular screw fixation used in both groups of this current study [12].

Kim *et al*. [5] have reported that the increase in postoperative serum CPK was significantly lower in the paraspinal approach (Wiltse) than the conventional approach. Comparable result was noticed in the current study as an increase in CPK was more in the conventional group than the Wiltse group. The decrease in CPK was in the Wiltse group, indicating less damage and atrophy of the paraspinal muscles.

The insignificant difference in our study may be attributed to the protocol of discharge in our hospital as the patients are usually discharged within 2 days postoperatively, if no complications were reported [7].

In this study, VAS score of back pain was significantly better in the Wiltse group when compared with that of the conventional one at the time of discharge from hospital. At the final follow-up at 6 months, both groups showed good pain reduction without significant difference between the two groups. Comparable results were found in the Jiang and colleagues study [12]. These authors reported that there was better VAS score of back pain in the Wiltse group when compared with that of the conventional one at 2 weeks' postoperative follow-up, while there was no significant difference between the two groups at the final follow-up at 6 months.

Despite the very high prevalence of LBP, its pathophysiology is poorly understood and there is a lack of an association between investigative findings and clinical symptoms. Several studies have argued that the lack of an association between radiographic pathology and pain essentially stems from the multifactorial nature of pain [13].

It is also possible that the poor association is due to factors that have not been evaluated by routine imaging, that is, degenerative changes in facet joints, ligamentous damage, and changes (traumatic or degenerative) in the -paraspinal muscles [14].

In this study, we used MRI at the final follow-up to assess the paraspinal muscle conditions in both groups.

MRI performed at 6-month follow up showed various types of muscles degeneration including fatty changes, inflammation, and scarring, Conventional approach was associated with more fatty degeneration and atrophy

than the Wiltse approach, which respects anatomical planes and utilizes a muscle-splitting technique.

However, there was no significant difference in VAS score of back pain between the two groups at the final follow-up at 6 months. Seiji Ohtori *et al*. [8] also reported that various pathologies of back muscle degeneration were evident after posterior lumbar surgery; fatty change was most prevalent; and other patients had scarring.

However, they reported that no type of back muscle degeneration was correlated with back pain after surgery. The reverse was reported by Kjaer *et al*. [15], who presented convincing evidence that fatty infiltration in the lumbar multifidus is strongly associated with LBP in adults.

In this study, functional recovery measured by ODI was better in patients treated by the Wiltse technique than the conventional technique at 3 months of follow-up, but no significant difference was noticed at the final follow-up. Also, Mohamed *et al*. [16] observed no significant difference in the functional recovery measured by ODI at 6-month follow-up.

The small sample from a single center and inclusion criteria were limited to patients with lumbar vertebral fractures without neurological deficits were the limitations of the study.

Conclusion

Wiltse approach had rapid recovery compared with the conventional approach. It was associated with less tissue dissection and bleeding compared with the conventional approach. It also had less early postoperative back pain with risk of muscle injury and atrophy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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