

Intermuscular Technique for Stabilization of Traumatic Thoracolumbar Fractures without Neurological Deficits

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BACKGROUND: Treatment of thoracolumbar fractures with less than 50% canal compromise is still controversial, especially in neurologically intact patients. Improved surgical techniques and implants may result in improved surgical stabilization outcomes.

OBJECTIVE: The purpose of this study was to assess the clinical and radiological outcomes of employing the intermuscular approach to treat traumatic thoracolumbar fractures without neurological impairment.

PATIENTS AND METHODS: Thirty patients with acute thoracolumbar fractures who did not have any neurological deficits participated in this retrospective analysis. Ten females and twenty males were included in this study and all patients had surgical stabilization using the intermuscular paraspinal method.

RESULTS: The first lumbar (L1) vertebra was the site of 35% of the fractures. Road traffic collision victims made up 64% of cases. A minimum of six months to fifteen months was spent monitoring every patient. The patients met the modified McNab criterion for satisfactory clinical outcomes. The results of sixteen cases (53%), twelve cases (40%), and two cases (7%), respectively, were deemed to be excellent, good, and fair. In every instance, vertebral body height (VBH) correction was attained. Long segment fixation was performed for all patients. Only four of the 240 screws that were used had grade-2 misplacement; yet all the patients recovered completely. All patients' fractures had healed six months after surgery.

CONCLUSION: The paraspinal approach has less operative time, less blood loss, and protects the paraspinal muscles and supraspinal and interspinal ligaments. It has a lower cost in comparison with percutaneous screws. In underdeveloped areas, it should be the first option for treating individuals who do not have any neurological impairment.

KEYWORDS: Intermuscular fixation, Thoracolumbar fracture, Paraspinal approach.

INTRODUCTION

There are no clear reports about the epidemiology of thoracolumbar fractures in Egypt. However, it still represents a high prevalence rate in other countries.¹

Treatment of thoracolumbar fractures with less than 50% canal compromise is still dubious, especially in neurologically intact patients.² Research had demonstrated that non-operative treatment comprising bed rest, braces, or casts is effective for patients. However, side effects from nonsurgical therapy can include pressure sores, prolonged recumbency, late neurologic impairment and residual kyphosis.³

Improved surgical techniques and implants may result

in improved surgical stabilization outcomes. Surgical treatment provides immediate spinal stability and a more reliable restoration of sagittal alignment, vertebral height, and canal dimension than cast or brace maintenance.⁴

Operative incision and dissection can be done by either through a conventional midline approach or an inter-muscular approach (which is also known as the paraspinal approach). For patients who retain their neurological function, the goal of surgery is to stabilize and align the spinal column rather than directly decompressing the vertebral canal. For the retropulsed vertebral body fragment to be indirectly reduced, tension in the posterior longitudinal ligament is required. Therefore, a laminectomy and subperiosteal dissection of the posterior paraspinal muscles is not necessary.⁵ Paraspinal muscles dissection has been associated with longer operating time, increased intraoperative bleeding, severe back pain following surgery, a delayed return to function, and worsened posterior ligamentous complex (PLC) injuries.⁶

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This study aimed to evaluate the clinical and radiological results of treating traumatic thoracolumbar fractures without neurological deficits by using the intermuscular technique.

PATIENTS AND METHODS

Thirty participants (20 males and 10 females) were included in this retrospective clinical study between February 2016 and July 2019. The age distribution was 28±11 years.

All patients signed informed consents for surgery and to participate in this study and after approval from the research ethics committee in Tanta and Suez Canal universities.

Patients included had a single level thoracolumbar spine fracture at any level between the eleventh thoracic (T11) and second lumbar (L2) vertebral levels. The patients were presented within 15 days following the injury. They had no neurological deficit, with less than 50% of the spinal canal's width being reduced by a retropulsion vertebral fragment and with load sharing forces less than or equal.^{6,7}

The posterior inter-muscular approach was used with follow-up periods of at least six months.

Individuals who had undergone spinal surgery in the past or who had pathological or osteoporotic fractures were excluded.

Neurological examination, physical examination, and patient history were all part of the preoperative evaluation. The dorsolumbar spine was imaged using anteroposterior, lateral, CT, and MRI scans.

Blood loss, the length of inpatient stay, and the length of operation were all documented for each patient. Major and mild problems during and after surgery were evaluated.

Postoperative CT scans to evaluate the precision of screw placement, were among the postoperative evaluation's components. Accuracy was evaluated using Youkilis et al.'s methodology.⁸ Class I concerns screw placement inside the pedicle without any cortical violation; Class II concerns cortical violation < 2 mm; and Class III concerns cortical violation > 2 mm.

To evaluate the healing of fractures and the correction of kyphosis, X-rays imaging were performed 3 weeks, 6 months, 9 months, and 12 months after surgery. The location of pain, the VAS score for leg and back pain intensity, neurological symptoms, medication, complications, recurrence of symptoms, and subsequent spinal surgery were all recorded during the follow-up visit. Using the modified McNab criteria, the clinical outcome of the patient was assessed. (Table 1).

Table 1: Data of the study group

Parameter	Total (30 patients)
Male / Female	20/10
Age (Years)	28.8
Mechanism of fracture:	
Fall from height	11
Road traffic accident	19
Fractured vertebral level:	
T11	2
T12	9
L1	16
L2	3
TLICS score:	
7	21
5	9
Load sharing score:	
4	7
5	6
6	17
Follow-up period (months)	6-15 (verage 8.9)
Blood Loss (ml)	125 ± 50
Surgical Time (min)	104 ± 20
Days in hospital	3.7 ± 2.7
The modified McNab criteria:	
Excellent	16 (53%)
Good	12 (40%)
Fair	2 (7%)
Poor	0
Mean kyphotic angle (Cobb method):	
Immediate postoperative time	0.6° ± 10.8°
3 months postoperatively	4.2° ± 11.2°
6 months postoperatively	9° ± 9.9°
12 months postoperatively	10.5° ± 10.3°
Loss of kyphosis correction (Cobb method) :	
3 months postoperatively	4.1° ± 3.6°
6 months postoperatively	6.2° ± 5.2°
12 months postoperatively	7.5° ± 4.4°
Vertebral body height (VBH) loss:	
Preoperative %	%50-80% (mean 67%)
Postoperative %	%60-90% (mean 74%)

Surgical technique

Patients were operated upon under general anesthesia, placed in a prone posture. All pressure points were padded using cotton rolls. The abdomen was hanging freely, and airway pressure was ensured to be within normal limits. After correct level confirmation using fluoroscopic imaging, a single mid-line skin incision was made. A dissection plan was developed between the subcutaneous layer and dorsolumbar fascia (The normal cleavage space). Then the fascia was incised away from the midline (1.5-2.5 cm). Using a probe or one's finger to palpate the lateral aspect of the facet joint in the lumbar area and the transverse processes of thoracic vertebrae, the natural cleavage line between the multifidus muscle medially and the longissimus muscle laterally can be

easily reached. Then blunt dissection using fingers will create the gutter in this plane. Using electrocautery one can identify the transverse process of lumbar vertebrae and facet joints in the thoracic region. These anatomical landmarks of pedicles can be confirmed radiologically. Inserting transpedicular screws was done as usual using a series of pedicle owls followed by a pedicle finder then the intraosseous pathway was confirmed by a feeler. The craniocaudal screws direction was guided by fluoroscopy. Rods are configured according to the anatomic spine curvature and tightened with pedicular screws. The

kyphosis correction was performed by distraction and ligamentotaxis as well. After ensuring good hemostasis, the incised fascia was sutured accurately to prevent muscle hernia. Closure of the skin was done by subcuticular sutures.⁹ (Figs. 1-4).

Statistical methods

The Fisher exact tests were used to evaluate contingency tables. p-values less than 0.05 were regarded as significant.

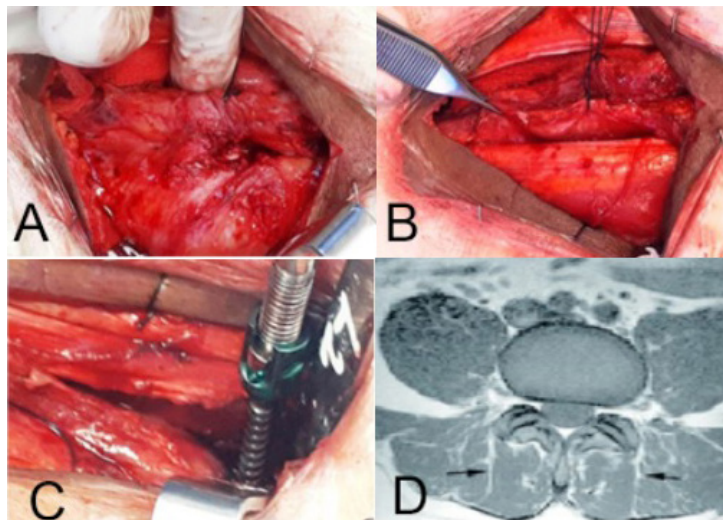


Fig 1: A-C: Using finger blunt dissection to enter the natural cleavage line between the multifidus and the longissimus muscle. D: This plane is demonstrated in MRI by the black arrow.

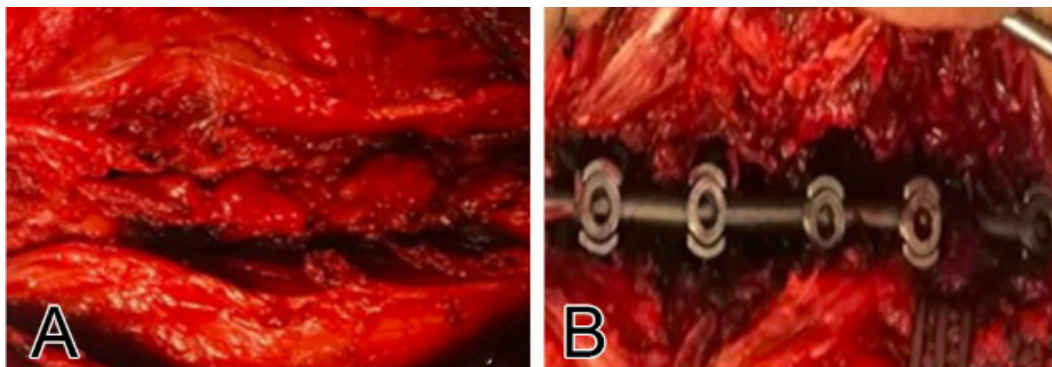


Fig 2: A: The natural cleavage between the 2 muscles after identification of pedicle entries. B: The final construct position in the gutter.

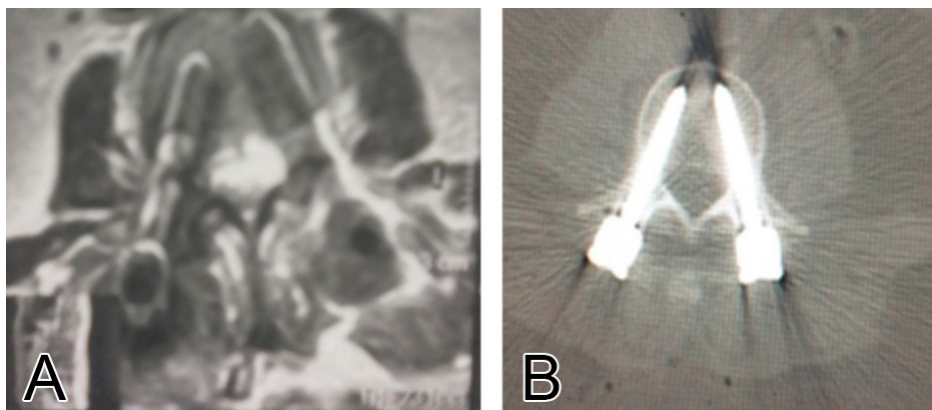


Fig 3: The trans-pedicular screws in the natural cleavage plane between the multifidus and longissimus muscles.



Fig 4: A: MRI dorsolumbar spine revealed L1 fracture. B: Post-operative X-rays revealed long segment fixation, kyphosis correction, and vertebral body height (VBH) restoration.

RESULTS

The study involved thirty patients, the mean age of the 20 males (67%) and 10 females (33%) was 28 ± 11 years. 53% of fractures were at the L1 vertebra. 64% of cases were victims of road traffic accidents. On the other hand, 36% of cases had their fracture after falling from height. Patients scoring according to TLICS and load-sharing scores are summarized in Table 1. Every patient received at least six months of follow-up (6-15 months), (mean was 8.9 months).

The mean operative time was 104 ± 20 minutes. The intraoperative blood loss ranged from 50 ml to 150 ml (mean 125 ml). The average patient hospitalization was 3.7 ± 2.7 days.

Based on the modified McNab criteria, patients had satisfactory clinical outcomes. The results of sixteen cases (53%), twelve cases (40%), and two cases (7%), respectively, were deemed to be excellent, good, and fair. All preoperative kyphotic deformities were corrected postoperatively. Vertebral body height (VBH) correction was achieved in all cases with a p-value (0.0001) which is statistically significant. The comparison between the VBH preoperatively and postoperatively were summarized in Table 1. All patients underwent long segment fixation. Only 4 screws, out of total 240 screws, showed grade 2 misplacement; however, all patients were intact postoperatively. At 6 months postoperatively, all patients had their fractures healed. The study group's mean kyphotic angle was $0.6^\circ \pm 10.8^\circ$, $4.2^\circ \pm 11.2^\circ$, $9^\circ \pm 9.9^\circ$, and $10.5^\circ \pm 10.3^\circ$ at the immediate postoperative period, 3, 6, and 12 months after surgery, respectively. At 3, 6, and 12 months after surgery, the average loss of kyphosis correction was $4.1^\circ \pm 3.6^\circ$, $6.2^\circ \pm 5.2^\circ$, and $7.5^\circ \pm 4.4^\circ$, respectively.

DISCUSSION

Watkins originally described the paraspinous approach—which passes via the region between the erector spinae and the musculus quadratus lumborum—as a lumbar

spondylolisthesis operation in 1959.¹⁰ Wiltse was the first to report it using the distance between the longissimus portion of the sacrospinalis and the multifidus muscle.¹¹ The Wiltse technique had been used because it makes it simpler to grant access to both the transverse process and the facet joint.¹¹

In our research, we utilized the Wiltse methodology to quickly detect the pedicles that do not exhibit muscle transgression, unlike the subperiosteal muscle dissection method. Because it is an avascular plane, this natural cleavage line reduced blood loss and operating time to a greater extent and ensured less post-operative muscle fibrosis.⁹

The mean age of the 20 males (67%) and 10 females (33%) in our series was 28 ± 11 years. Of the patients, 53% had an L1 spinal fracture, and 64% had been involved in a car collision. The percentages in these demographic data are comparable to those in the study of Jiang et al.¹²

Jiang et al reported that the procedure took 121.4 ± 19.6 minutes utilizing the open conventional approach, and 218.7 ± 32.3 ml of blood was lost. Nonetheless, the paraspinous method led to a shorter operating duration and reduced blood loss; the procedure took 76.2 ± 15.7 minutes, and the amount of blood lost was 91.6 ± 16.9 milliliters, both of which were statistically significant.¹² When comparing the blood loss from this method to the percutaneous one, Sun et al. reported a range of 50 ml to 300 ml.⁴ In this study the range of blood loss was from 50ml to 150ml.

Compared to this study (the mean surgical time is 104 ± 20 minutes) while, Sun et al.'s paraspinous group had an operating time of 70–130 minutes.⁴

The results of the present research demonstrated a 100% correction of the vertebral body height and local kyphotic deformity; this was comparable to the findings of the previous two researches and to the conventional method.^{4,12}

Liu Zhonghao et al. demonstrated similar outcomes in terms of operating time, blood loss, and kyphosis correction in their comparison study between the Wiltse technique and the traditional approach.¹³

In order to compare traditional, paraspinous, and percutaneous approaches, Sun et al. conducted a meta-analysis utilizing 4 randomized controlled trials and 14 observational articles. The results indicated that there was no significant difference between the paraspinous and percutaneous approaches in terms of postoperative VBH percentage, intraoperative fluoroscopy, or operating duration.⁴

Our patients met the modified McNab criteria with satisfactory clinical results. It was determined that sixteen cases (53%), twelve cases (40%), and two cases (7%), had outstanding, decent, and fair outcomes, respectively.

Numerous studies that employed different ratings to

evaluate the results of thoracolumbar fractures treated with various conventional and minimally invasive techniques revealed that there was a difference in postoperative midterm VAS, kyphosis angulation, and VBH between all groups.^{14,15} However, the least invasive methods were preferred due to the surgical imprint on the multifidus muscle.¹⁶

CONCLUSION

The paraspinous approach has less operative time, less blood loss, and protects the paraspinous muscles and supraspinous and interspinous ligaments. The paraspinous approach has a lower cost in comparison with percutaneous screws. It should be the first choice in the treatment of the patient without neurological deficits in poor communities.

List of Abbreviations

CT: Computed Tomography.

MR I: Magnetic resonance Imaging.

PLC: Posterior ligamentous complex.

TLICS: Thoracolumbar injury classification and severity score.

VAS: Visual Analogue Score.

VBH: Vertebral body height.

Disclosure

The authors report no conflict of interest in the materials or methods used in this study or the findings specified in this manuscript.

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