

# 10 Year Follow-Up of Thoracolumbar Junction Fractures - Functional and Radiographic Analysis of Two Posterior Short-Segment Surgical Techniques

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**Received:** April 20, 2021; **Published:** May 28, 2021

## Abstract

**Background:** There are several different surgical options considering treatment of fractures of the thoracolumbar junction. This study aims to present and offer the results of two different surgical techniques to treat spine fractures between T10 and L2.

**Methods:** 48 patients who undergone posterior spine fixation for thoracolumbar fracture were selected. They were divided into two groups: group A, which comprised 26 patients, had instrumentation and technique involving the vertebra below the fracture and two vertebrae immediately above the lesion, without fixing the fractured vertebra ("two above, one below group"). In the group B, which had 22 patients, the instrumentation occurred in the affected vertebra or fractured vertebra, and also only one level above and below the lesion.

**Results:** Clinical status analysis and radiographic comparison were performed between the preoperative and a minimum of 10 year postoperative follow-up.

**Conclusion:** The present article showed that both techniques are effective for the correction of post-traumatic kyphotic deformities, although the technique with two screws above and one below has been proved to be the best one.

**Level of Evidence IV:** Case series.

**Keywords:** *Thoracolumbar Junction; Short-Segment Instrumentation; Spinal Fractures*

## Introduction

Spinal fractures are related to high-energy trauma and represent 3% of all fracture cases. From these cases, 10% are followed by spinal cord injury and 75% occur in the thoracolumbar junction, between T10 and L2 [11,16].

The surgical treatment, when needed, aims for stabilization and deformities correction, providing spinal functionality [8,6].

Among the radiographic evaluation methods of post-traumatic kyphosis, the Cobb method provides parameters for evaluation and deformities correction, performing an important role in decision making [10].

From the mentioned techniques to perform arthodesis via a posterior approach for thoracolumbar (TL) junction fractures, the pedicle screw fixation two levels above and two levels below the fracture is traditionally performed, which is called as long fusion [7]. However, there can be seen short-segment fixation techniques, where instrumentation occurs in one level above and one below the fractured vertebra, avoiding the fusion of healthy and adjacent levels [7].

Regarding the short-segment fixation techniques via a posterior approach, mainly performed for patients that do not show neurological deficit, fixation systems with pedicle screws or Schanz pins [1] have been reported, as well as variations of these techniques with screws fixation on the fracture vertebra [9,12].

Throughout time, several scientific works about thoracolumbar spine fractures have been published, however there is no consensus regarding the best treatment for each spine region: thoracic, thoracolumbar and the lumbar region [3]. On a general basis, treatment of TL junction fractures has been defined by the routine of each service, taking into consideration the pedicle integrity, fracture comminution, surgeon experience and the load-sharing classification > 6 [17,18].

### Aim of the Study

The present study aims to contribute for an accordant protocol establishment upon TL junction fractures by evaluating and proposing a variation of the common short-segment technique. The surgical technique would be performed on only one vertebra below and two vertebrae above the fracture, and a comparison of this variation with the traditional short construct fixation technique will be presented. For both techniques, this study will present the radiographic and functional long-term results of a minimum 10 year postoperative follow-up.

### Methods

A retrospective investigation has been made, involving patients who underwent a posterior surgical treatment and who were diagnosed with fracture of the TL junction, at a single Orthopaedic and Traumatology institution, during the period from 2007 to 2010, by the same surgeon. All of those patients with fractures out of the TL junction; diagnosed with nontraumatic fracture; who underwent different surgical techniques than the ones addressed in this work; as well as those who presented incomplete data records and/or no radiographs and finally, those whose follow-up was less than 10 years and those who underwent surgery 10 or more days after the trauma, were excluded.

The sample consisted of 48 patients, who were divided into groups A and B according to the performed technique, both comprising the use of six monoaxial pedicle screws. The group A was called by the authors as “two above, one below group”, had instrumentation and technique involving the vertebra below the fracture and two vertebrae immediately above the lesion, without fixing the fractured vertebra. In the group B, called as “short fusion group”, which the instrumentation occurred in the fractured vertebra and also only one level above and one below the lesion.

The patients group and the surgical technique selection was held according to the pedicle integrity and fractured vertebra comminution level. All procedures were performed through a single posterior approach by the same surgeon.

Preoperative radiographs have been evaluated in anteroposterior and lateral incidence, as well as multislice computed tomography with three dimensions reconstruction. The postoperative follow-up was based on the radiographs evaluation of anteroposterior and lateral incidence in two moments: immediate postoperative up to 48 hours and late postoperative with minimum 10 years.

Concerning the post-traumatic kyphosis, the analysis comprised the evaluation of: 1) the difference of kyphosis angles in immediate pre and postoperative; 2) correction loss, comprising the difference between the angles of immediate postoperative and final postoperative (10 year follow-up).

The kyphosis angle was measured by the traditional Cobb's method, which consists in drawing a line to the upper border of the immediate vertebra above the fracture, other on the lower border of the immediate vertebra below it and the intersection of their perpendiculars [8].

The classification of Magerl has been used for all the patients, adopted by the AO group (Arbeitsgemeinschaft für Osteosynthesefragen) which divides in types A (compression), B (distraction) e C (rotation), and the TLICS classification (Thoracolumbar Injury Classification and Severity Score) that establishes a score system taking into consideration the injury morphology pattern, posterior ligamentous complex integrity and the patient neurology [4]. Furthermore, patient demographics and baseline characteristics were recorded, including age, sex, etiology, injured vertebra and neurological impairment, according to the American Spine Injury Association (ASIA) scale.

Postoperative patients were clinically evaluated at the final visit. For this evaluation of pain and clinical status the Oswestry Disability Index (ODI) was applied, in the Brazilian version, translated by Vigatto, *et al.* which determines percentage of disability for back pain [19].

### Results

Among 48 patients involved in this study, 36 (75%) were male and 12 (25%) were female. The average age of the patients at the time of the surgery was 37 years old (minimum 17 years and maximum 67 years old). All patients underwent surgical procedure and were followed up for an average period of 11,5 years, which varied from 10 to 13,2 years of follow-up.

The most common affected vertebrae was L1 (75%), predominantly AOSpine type A, representing 45,8% of patients, followed by AOSpine type B (distraction), 37,5%, and type C (rotation), with 16,6%. Considering TLICS classification, group A achieved an average of 5.3 points and group B, 5.09 points.

Regarding surgical technique, authors divided the sample in two types of instrumentation: group A receiving screws two levels above and one level below, which represented 26 patients, and group B, receiving spinal instrumentation in the fractured vertebra plus one level above and one level below, represented by 22 patients (Figure 1 and 2).



**Figure 1:** Posterior approach group A - "Two above and one below group".



Figure 2: Posterior approach group B - "Short fusion group".

Among 48 patients, only two had neurologic injury prior to their surgery, ASIA D, both made full recovery along their follow-up.

Overall, the results for surgical treatment had a good outcome for all patients. Considering differences between Cobb angle correction. Table 1 shows an analysis between preop and immediate postoperative in groups A and B. Authors could not see any significant statistically difference between these 2 groups, not only for the preop period ( $p = 0,941$ ) as for the immediate postop period ( $p = 0,316$ ), although greater correction was observed in group A.

	n	Minimum angle	Maximum angle	Average Angle	Standard deviation	p*
<b>Group A</b>						
Preop	26	7,0	38,0	18,62	9,33	0,941
Immediate postoperative	26	2,0	25,0	8,15	7,66	0,316
<b>Group B</b>						
Preop	22	9,0	33,0	18,36	7,13	0,941
Immediate postoperative	22	2,0	30,0	11,27	7,20	0,316

Table 1: Comparative Cobb angle analysis between preop and immediate postop periods for both groups.

\*: Sample t Test.

Table 2 presents an analysis between immediate postoperative and final postoperative for both groups. Authors did not find a statistically significant difference considering average angles in the final postoperative period ( $p = 0,156$ ). However, there was a slight tendency showing group A patients kept a better angle of correction in a long term analysis.

	n	Minimum angle	Maximum angle	Average Angle	Standard deviation	p*
<b>Group A</b>						
Immediate postoperative	26	2,0	25,0	8,15	7,66	0,316
Final postoperative	26	2,0	25,0	8,85	7,73	0,156
<b>Group B</b>						
Immediate postoperative	22	2,0	30,0	11,27	7,20	0,316
Final postoperative	22	4,0	30,0	13,45	7,55	0,156

**Table 2:** Comparative Cobb angle analysis between the immediate postop and final postop periods for both groups.

\*: Sample t test.

Table 3 presents percentage of correction between preop and final postop and loss of correction for both groups for the same period. A slight difference was seen, group B showing a greater long-term loss of correction.

Percentage of correction	A	B
Immediate postoperative	59,0%	40,6%
Final postoperative	54,1%	33,9%
Loss of correction in relation to immediate postoperative gain	1,46°	2,55°

**Table 3:** Percentage of correction and loss of correction between preop and final postop for both groups.

\*: Sample t test.

The clinical results from this study showed a “good” result in the ODI questionnaire for both groups, 24% of incapacity for group A and 28% for group B.

## Discussion

In spine surgery, there is an ongoing effort to provide patients a faster recovery allowing them to walk and get back to their routines early after surgery [13,14].

There are several different techniques considering fractures of the thoracolumbar junction. The long-segment instrumentation technique has the advantage of being a more stable construct, necessary to avoid loss of correction and kyphosis on TL junction [7]. The short-segment instrumentation technique, which comprises instrumentation of one vertebra above and other below the fractured vertebra, however, has the advantage of avoiding fusion of healthy adjacent levels and aggression on soft tissues [7].

McLain[13] reports that the long-segment technique as well as the short one can be used, however the long technique is recommended particularly for more unstable fractures.

Knop., *et al.* [9] made a revision of the late results of the clinical and radiographic evaluation of 56 patients after arthrodesis via a posterior approach of TL fractures with transpedicular technique and short arthrodesis. The radiographic evaluation has proved a significant loss of the previous angle correction (10,1o, Cobb’s method), highlighting that the fixation with four screws can be insufficient.

Marin., *et al.* [12] showed minimum disability index scores (Oswestry 16,6%), when using combined anterior and posterior monosegmental fixation technique. The average correction shown was from 20,330 at preop to 12,30 at immediate postop, with significant loss

on the final evaluation (average of 19,50), highlighting that the short fixation with double approaches seemed to be insufficient for the surgical treatment on TL junction traumatic injuries.

Despite the fact long-segment instrumentations tend to provide greater stability, on the other hand they tend compromise patient mobility. For this reason, adaptations from long fusions were made in order to avoid more than one level below the fractured vertebra. To date, good clinical and radiographic results were confirmed with all 48 patients evaluated in this study.

Although there is not a specific traumatic spine questionnaire, the Oswestry Disability Index remains the most common used [5,15]. Authors did not observed correlation among loss of correction and functional outcome, same was seen in the study of Bortoletto, *et al* [2].

There are some limitations of the present article such as sample size, which can be considered small, and the inclusion criteria to select patients into different groups. However, as the main goal of this study is to describe fractures only in the thoracolumbar junction with a 10 years minimum follow-up, the number of patients can be considered acceptable.

In summary, both techniques showed to be effective and authors had the positive impression that instrumentation in only one vertebra below the fractured vertebra is enough to keep alignment, avoiding further soft tissue invasion and possible loss of mobility, although for more instable burst and type C fractures, two level above fixation might be the best option.

### Conclusion

Authors suggest two modifications of the traditional long instrumentation fusion techniques to treat traumatic pathology of the TL junction, none of them going more than one level below the fractured vertebra. Both techniques showed to be effective in the management of TL junction traumatic pathology, although the technique that uses two levels above and one vertebra below seemed to be slightly better, due to a greater postoperative Cobb angle correction and less loss of correction in a long-term perspective.

### Conflicts of Interests

Authors declare not having any conflict of interest.

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**Volume 12 Issue 6 June 2021**

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