

TREATMENT OF THORACOLUMBAR BURST FRACTURES FIXED WITH INTERMEDIATE PINS BY THE POSTERIOR APPROACH

TRATAMENTO DE FRATURAS TORACOLOMBARES TIPO EXPLOSÃO COM FIXAÇÃO COM PINOS INTERMEDIÁRIOS PELA VIA POSTERIOR

TRATAMIENTO DE LAS FRACTURAS TORACOLUMBARES TIPO EXPLOSIÓN CON TORNILLOS INTERMEDIOS POR VÍA POSTERIOR

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ABSTRACT

Objective: Radiographic evaluation of patients with thoracolumbar burst fractures treated with unconventional transpedicular fixation, which includes additional fixation of the fractured vertebra associated with transverse connector – Crosslink clamp. **Methods:** Retrospective study evaluating a total of 68 patients operated at the Hospital do Trabalhador de Curitiba, Orthopedics Service, of which 15 were eligible for the study. All patients were treated with posterior pedicle fixation and intermediate screw. The assessment by the Cobb angle method was performed on preoperative, immediate postoperative and one year after surgery radiographs. **Results:** It was observed an average reduction of kyphosis of 8.3° (77%), with a loss of 1.34° in late postoperative compared to the immediate postoperative period. **Conclusion:** The method of fixation of burst-type fractures of the thoracolumbar spine by the posterior approach with intermediate screw was effective in maintaining the reduction achieved in the immediate postoperative period and after one year of evolution.

Keywords: Spinal fractures/surgery; Bone screws/surgery; Kyphosis.

RESUMO

Objetivo: Avaliação radiográfica de pacientes com fraturas toracolombares do tipo explosão, tratados com fixação transpedicular não convencional, que inclui a fixação adicional da vértebra fraturada associada ao uso da barra de conexão transversal - Crosslink clamp. **Métodos:** Estudo retrospectivo com 68 pacientes operados no Hospital do Trabalhador de Curitiba, serviço de Ortopedia, dos quais 15 foram elegíveis para a pesquisa. Todos os pacientes foram tratados com fixação pedicular posterior e com parafuso intermediário. Foi realizada a avaliação pelo método do ângulo de Cobb das radiografias pré-operatória, pós-operatória imediata e com um ano de pós-operatório. **Resultados:** Foi observada a redução média da cifose de 8,3° (77%), com uma perda de 1,34° no pós-operatório tardio em relação ao pós-operatório imediato. **Conclusão:** O método de fixação de fraturas tipo explosão da coluna toracolombar por via posterior com parafuso intermediário mostrou-se eficaz na manutenção da redução obtida no pós-operatório imediato e após um ano de evolução.

Descritores: Fraturas da coluna vertebral/cirurgia; Parafusos ósseos/cirurgia; Cifose.

RESUMEN

Objetivo: Evaluación radiográfica de los pacientes con fracturas toracolumbares de tipo explosión tratados con fijación transpedicular no convencional, que incluye la fijación adicional de la vértebra fracturada asociada con el uso de barra de conexión transversal – Crosslink clamp. **Métodos:** Estudio retrospectivo de 68 pacientes operados en el Hospital do Trabalhador de Curitiba, Servicio de Ortopedia, de los cuales 15 eran elegibles para el estudio. Todos los pacientes fueron tratados con fijación pedicular posterior y tornillo intermedio. Se realizó la evaluación por el método del ángulo de Cobb en las radiografías preoperatorias, postoperatorias inmediatas y un año después de la cirugía. **Resultados:** Se observó una reducción promedio de 8,3° de la cifosis (77%), con una pérdida de 1,34° en el postoperatorio tardío en comparación con el postoperatorio inmediato. **Conclusión:** El método de fijación de las fracturas de tipo explosión de la columna toracolumbar por la vía posterior con el tornillo intermedio fue eficaz en el mantenimiento de la reducción lograda en el período postoperatorio inmediato y después de un año de evolución.

Descriptores: Fracturas de la columna vertebral/cirugía; Tornillos óseos/cirugía; Cifosis.

INTRODUCTION

Approximately 75% of all spine fractures occur in the thoracolumbar regions, with 30% in the thoracic spine and 45% in the lumbar spine.¹ Burst-type fractures account for around 60-70% of the thoracolumbar fractures that are treated surgically.¹⁻⁴ Most burst fractures involve the thoracolumbar junction, which is particularly susceptible to this type of injury due to its location, and the transitional anatomy between the kyphotic and rigid thoracic spine and the more mobile and lordotic lumbar spine. Unlike purely compressive fractures in which the mid-spine remains intact, burst-type lesions are typically

associated with some degree of occlusion of the spinal canal, which can result in neurological deficit.

Burst-type fractures of the thoracolumbar spine are defined as fractures caused by axial compression force associated with different degrees of flexion, causing comminution of the vertebral body that can affect the spines classified by Denis², in various ways. A vertebral fracture with severe comminution does not transfer the load as effectively as a non-fractured vertebra, exposing the posterior elements of the spine to a hinged movement of force, leading to

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progressive kyphotic deformity. These lesions are therefore considered unstable.^{2,4}

The vast majority of thoracolumbar fractures are treated non-surgically,⁵ including burst fractures with little or no neurological involvement,⁶ which, according to Denis, are the result of a failure in the vertebral body resulting from an axial load, causing the collapse of the vertebral body and the projection of bone fragments into the vertebral canal. For this reason, the criteria of biomechanical instability of the spine, such as compression of more than 50% of the vertebral body, kyphosis greater than 20%, and the involvement of two or more of Denis' spines, must be observed. The presence of any compromise of the spinal canal with neurological deficit contraindicates conservative treatment.^{7,8}

Surgical treatment with transpedicular fixation has been beneficial in managing thoracolumbar fractures by enabling correction of kyphotic deformity, increased initial stability, painless early mobilization, and indirect decompression of the spinal canal.⁷⁻¹²

Traditional transpedicular fixation consists of the fixation of the vertebrae above and below the fractured vertebra, but not of the fractured vertebra itself. Transpedicular short segment fixations became popular after the introduction of transpedicular screws by Roy-Camille et al.¹³ and of internal fixation devices by Dick et al.¹⁴ This technique involves the fixation of the vertebra above and the vertebra below the fracture, with transpedicular screws. Although this technique has many advantages, it has high rates of loss, of reduction and failure of the implant material.^{15,16}

Stabilization of the fracture by anterior approach combined with posterior transpedicular fixation increases the morbidity of the treatment due to the greater surgical exposure, hospitalization time, and postoperative complications.^{17,18} In vitro biomechanical studies have shown that stabilization of the anterior spine associated with transpedicular fixation is superior, under axial load and flexion, to traditional transpedicular fixation.^{19,20}

Posterior transpedicular fixation for vertebral arthrodesis is frequently used for the surgical treatment of unstable fractures of the thoracolumbar spine because it provides reduction (correction of the kyphotic angle), and offers adequate stabilization of the three spines, while at the same time, indirect decompression of the vertebral canal by distraction and ligamentotaxis moves the previously retropulsed fragments away from the neural structures.²¹

In the past, pedicle screws inserted into the fractured vertebra were added as part of the short segment fixation. These were known as fixation with intermediary screws.¹⁴ Anekstein et al.²² postulated that the insertion of intermediate screws would improve the distribution of loads on the implant and the anterior spine, reducing both fatigue on the screw (material failure) and the chances of loss of reduction at the focus of the fracture.

Transpedicular fixation with intermediary pins includes the additional fixation of the fractured vertebra, whether associated or not with the use of a transversal connection rod. It has already been evaluated by Hart et al.³ together with other different types of fixation. The use of additional fixation combined with the transversal stabilizer increases mechanical rigidity and the stability of the entire assembly.^{20,23}

A published study has shown that additional fixation of the fractured vertebra by the posterior approach is only equivalent to stabilization by the anterior approach and by the posterior approach in relation to the biomechanical issue.²³

Few studies have been published to date that demonstrate clinical and radiographic results, rates of pseudoarthrosis, postoperative complications, maintenance of stability, and fracture reduction using this intermediary fixation technique.

The objective of this study is to perform a radiographic evaluation of patients with burst-type thoracolumbar fractures treated with non-conventional transpedicular fixation, which included additional fixation of the fractured vertebra associated with the use of a transversal connector rod.

MATERIALS AND METHODS

The retrospective study was conducted at the Hospital do Trabalhador de Curitiba, Curitiba, PR, Brazil, where the medical records of patients who underwent surgery for burst fractures of the thoracolumbar spine during the period from January 2004 to October 2008, were reviewed using the following inclusion criteria:

- AO A3 type fracture.
- Fixation with Schanz pins in the fractured vertebra, one level above and one below.
- Postoperative follow-up of a minimum of one year.

The Voluntary and Informed Consent Form was not Required.

The patient surgeries were performed by means of transpedicular fixation using the Magerl technique²⁴ and reduction using the ligamentotaxis technique²¹ with Schanz pins of multiple diameters (5 mm, 6 mm, and 7 mm) from Synthes® and GM Reis® (Brazil) in the fractured vertebra, using a longitudinal rod and cross-link system.

Preoperative tomography and x-rays were evaluated to classify the burst fracture (AO A3). (Figure 1) The angle was evaluated using the Cobb method in the preoperative and immediate postoperative periods and after one year of follow-up of the fractures. (Figures 2 and 3)

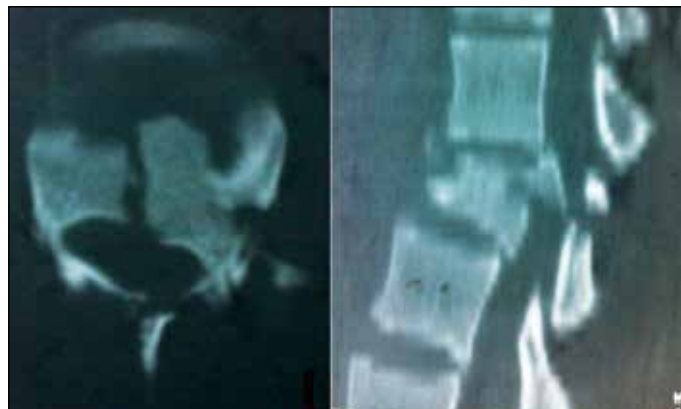


Figure 1. Tomographic image of AO A3 fracture (burst) in axial and sagittal sections.

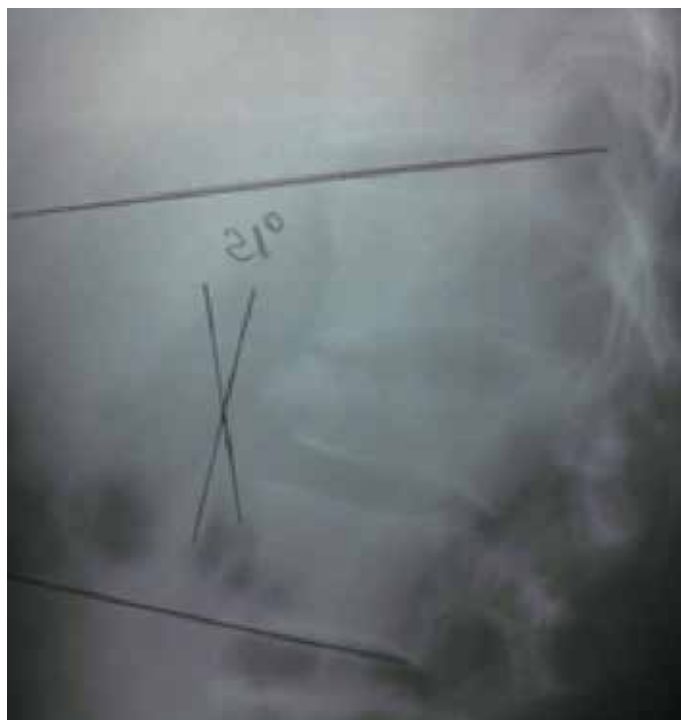


Figure 2. Preoperative measurement of kyphosis of the injured segment using the Cobb method.

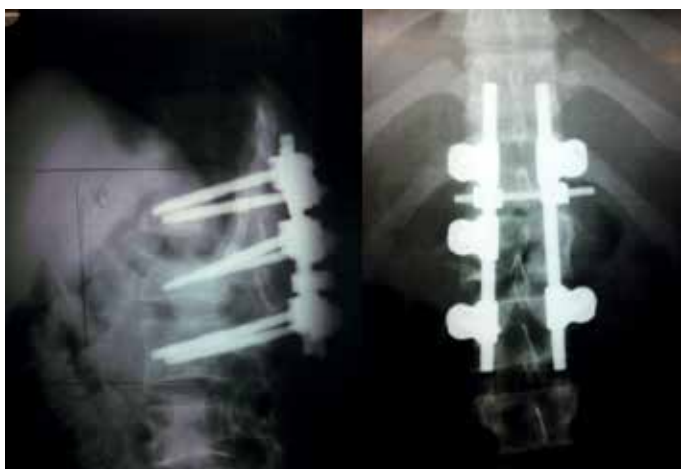


Figure 3. Fracture fixed with intermediate screws. Profile (d) and AP (e).

Statistical analysis was performed using the Student's t-test to verify whether or not there was variation among the samples and between the angles measured in the preoperative, immediate postoperative and late postoperative periods. The ANOVA method was used to assess the level of significance.

RESULTS

In total, 68 patients underwent surgery with fixation of the fractured vertebra during the period studied. Fifteen patients were included in the study. Among those excluded were seven with more than 3 fixed vertebrae, eighteen for having had follow-up of less than a year, twelve for fractures not classified as AO A3, and sixteen for incomplete information in their medical records.

The patient ages ranged from 18 years to 63 years, with an average age of 37.9 years of age. Of the 15 patients, one was female and 14 were male. (Table 1)

Statistical Analysis

Statistical analysis by the Student's t test, comparing the angles measured preoperatively with those measured in the immediate postoperative period, indicated that there was statistical difference between the angles. (Table 2)

Table 1. Data collected from patients included in the study.

Patients	Sex	Age	Pre-op	IPO	LPO
1	Male	36	28°	21°	22°
2	Male	43	24°	9°	9°
3	Male	40	18°	3°	6°
4	Male	19	21°	4°	4°
5	Male	46	19°	14°	14°
6	Male	20	21°	4°	10°
7	Male	51	4°	13°	13°
8	Male	63	20°	10°	10°
9	Male	42	22°	14°	14°
10	Male	18	20°	13°	13°
11	Male	56	10°	16°	16°
12	Male	56	13°	8°	8°
13	Male	18	24°	9°	12°
14	Male	42	14°	2°	9°
15	Female	19	30°	24°	24°

Pre-op=Preoperative; IPO=Immediate postoperative; LPO=Late Postoperative

Table 2. Student's t-test evaluating the angles in the preoperative and immediate postoperative periods.

	Pre-op	IPO
Average	19.2	10.93333333
Variance	45.6	41.4952381
P (T≤t) one-tailed	0.000943496	
t critical one-tailed	1.701130908	
P (T=≤t) two-tailed	0.001886992	
t critical two-tailed	2.048407115	

Statistical analysis by the Student's t-test comparing the angles measured preoperatively with those measured in the late postoperative period show that there was a significant difference. (Table 3)

Table 3. Student's t-test comparing the preoperative and late postoperative angles.

	Pre-op	LPO
Average	19.2	12.26666667
Variance	45.6	29.35238095
P (T≤t) one-tailed	0.002235828	
t critical one-tailed	1.703288423	
P (T≤t) two-tailed	0.004471655	
t critical two-tailed	2.051830493	

The statistical analysis using the Student's t-test comparing the average angles in the late postoperative period with those of the immediate post-operative period showed that there was no significant difference. (Table 4 and Figure 4)

Table 4. Student's t-test comparing the angles in the immediate and late postoperative periods.

	LPO	IPO
Average	12.26666667	10.93333333
Variance	29.35238095	41.4952381
P (T≤t) one-tailed	0.272336751	
t critical one-tailed	1.703288423	
P (T≤t) two-tailed	0.544673502	
t critical two-tailed	2.051830493	

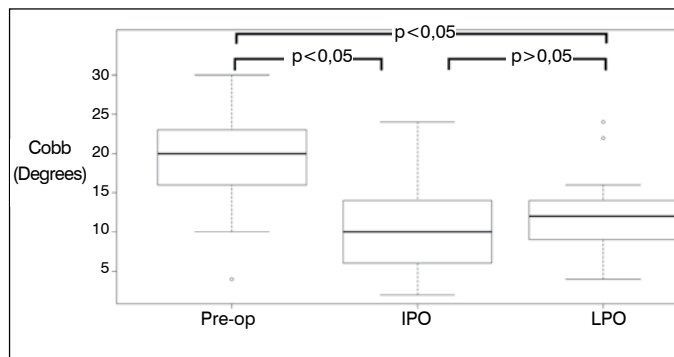


Figure 4. Values of the angles of the fractured vertebral segment in the preoperative, immediate postoperative, and late follow-up periods. Note the statistical differences between the groups.

The difference in the degrees in the sample was confirmed as significant using ANOVA at a confidence level of 95%, the p-value being equal to 0.00151 and the F calculated equal to 3.21994. (Table 5)

Table 5. ANOVA Test.

Group	Count	Sum	Average	Variance		
Pre-op	15	288	19.2	45.6		
IPO	15	164	10.93333	41.49524		
LPO	15	184	12.26667	29.35238		
Source of Variation	SS	DF	MS	F	p-value	F-crit
Between groups	590.9333	2	295.4667	7612006	0.00151	3.219942
Within the groups	1630.267	42	38.81587			
Total	2221.2	44				

SS - sum of squares, MS - mean squares, DF - degrees of freedom, F - F test.

DISCUSSION

Burst-type thoracolumbar fractures are very common in patients who suffer high-energy trauma. The fact that it is a transitional region predisposes it to this type of fracture.^{1,4,25} Studies conducted in our service have already demonstrated this epidemiology,²⁶ hence the interest in studying the best way to treat them.

Previous studies have shown that the thoracolumbar spine presents a high rate of consolidation between 3 and 6 months, rarely observing loss of reduction and pseudoarthrosis after one year.^{9, 27,28}

The posterior isolated segmented and combined anterior and posterior approach techniques of fixation for thoracolumbar fractures have been being evaluated for a while, but to date, few studies have

been developed to evaluate fixation of thoracolumbar fractures with intermediate screws via the posterior approach only.^{15,17,19}

The average reduction obtained in the immediate postoperative in relation to the preoperative was 8.3° (77%). This result coincides with the medical literature, in which the average reduction was 12° or 87%.^{17,21}

Studies such as those by Verlaan et al.¹⁷ and Korovessis et al.¹⁰ demonstrate significant postoperative losses of reduction for posterior isolated segmented fixations, varying from 13° for long fixations to almost 50% loss in short fixations. Unlike the published studies, in our study, we observed an average loss of 1.34° in reduction one year following surgery, which was not statistically significant (p<0.05).

Through analysis of the data obtained, we observed that the burst-type thoracolumbar fracture fixation technique using the intermediate Schanz pin from the posterior approach was successful and efficient in maintaining the reduction and stability of the fracture, just as Wang et al.¹⁹ had already shown in in vitro studies – all using only posterior access, without the need for intervention via the anterior approach, causing less damage to the patient and keeping the spine in the proper anatomical position.

More randomized, prospective studies with greater numbers of cases should be conducted to compare the different fixation methods so that we can better define which technique is most efficient in the treatment of thoracolumbar fractures.

CONCLUSION

The technique of posterior fixation of burst-type thoracolumbar fractures using the Schanz intermediate pin proved to be effective in the reduction of fractures and in the maintenance of this reduction one year after surgery.

All authors declare no potential conflict of interest concerning this article.

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