

RADIOGRAPHIC EVALUATION OF THE USE OF TRANSVERSE TRACTION DEVICE IN VERTEBRAL ARTHRODESIS FOR DEGENERATIVE DISEASES

AVALIAÇÃO RADIOGRÁFICA DO USO DO DISPOSITIVO DE TRAÇÃO TRANSVERSA NAS ARTRODESES VERTEBRAIS DE PATOLOGIAS DEGENERATIVAS

EVALUACIÓN RADIOGRÁFICA DE LA UTILIZACIÓN DEL DISPOSITIVO DE TRACCIÓN TRANSVERSAL EN LA ARTRODESIS VERTEBRAL PARA LAS ENFERMEDADES DEGENERATIVAS

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ABSTRACT

Objective: Perform radiographic analysis of the use of Transverse Traction Device (DTT) with respect to fusion rate in patients submitted to vertebral arthrodesis for degenerative lumbar diseases. **Methods:** We selected x-ray images on anteroposterior, lateral and oblique views and with maximum flexion and extension dynamics of 23 patients submitted to posterolateral arthrodesis of the lumbar spine with a minimum follow-up period of six months. The images were evaluated and classified by the Linovitz's system by two spine surgeons. **Results:** We evaluated the radiographs of 23 patients after the minimum postoperative period of 6 months and of these, 11 have used DTT. With regard to the consolidation rate, seven patients (63.6%) in the group of DTT were classified as fusion as well as six patients (50%) who were not submitted to the treatment. There was no statistical difference between the groups regarding the consolidation rate. **Conclusion:** The use of transverse traction device in this study showed no significant difference in the rate of consolidation in radiographic evaluation. Studies on the effective participation of this device in the stability of pedicle fixation systems are still lacking in the literature.

Keywords: Spinal fusion; Surgical fixation devices; Spine.

RESUMO

Objetivo: Realizar análise radiográfica do uso do dispositivo de tração transversa (DTT) quanto a taxa de consolidação em pacientes submetidos à artrodese vertebral da coluna lombar em patologias degenerativas. **Métodos:** Foram selecionadas radiografias nas incidências anteroposterior, perfil, oblíquas e dinâmicas em flexão e extensão máxima de 23 pacientes submetidos à artrodese posterolateral da coluna lombar com seguimento pós-operatório mínimo de seis meses. As imagens foram avaliadas e classificadas pelo sistema de Linovitz, por dois cirurgiões de coluna. **Resultados:** Avaliamos as radiografias de 23 pacientes no pós-operatório mínimo de 6 meses sendo que destes, 11 fizeram uso do DTT. Quanto à taxa de consolidação foram classificados como fusão sete pacientes (63,6%) no grupo que recebeu o DTT e seis pacientes (50%) naqueles em que o dispositivo não foi utilizado. Não observamos diferença estatística entre os grupos quanto à taxa de consolidação. **Conclusão:** A utilização do dispositivo de tração transversa neste estudo não apresentou diferença significativa quanto à taxa de consolidação na avaliação radiográfica. Ainda faltam na literatura estudos sobre a efetiva participação deste dispositivo na estabilidade dos sistemas de fixação pedicular.

Descritores: Fusão vertebral; Dispositivos de fixação cirúrgica; Coluna vertebral.

RESUMEN

Objetivo: Análisis del uso del dispositivo de tracción transversal (DTT) respecto a la tasa de consolidación en las enfermedades degenerativas de la columna vertebral en pacientes sometidos a la artrodese, a partir del estudio de los resultados radiológicos. **Métodos:** Se seleccionaron radiografías de la zona anteroposterior, oblicua y de perfil, así como, dinámicas de la flexión y extensión máxima, de 23 pacientes sometidos a la operación quirúrgica de artrodese posterolateral de la columna lumbar, con un mínimo de seis meses después de la realización de la cirugía. Las imágenes fueron evaluadas y clasificadas mediante el sistema de Linovitz por dos cirujanos de columna. **Resultados:** Evaluamos las radiografías de 23 pacientes después de la cirugía, mínimo de seis meses después y en 11 de los 23 pacientes anteriormente mencionados, se usó DTT. En cuanto a la tasa de consolidación, siete pacientes (63,6%) fueron clasificados como de fusión en el grupo con la DTT, así como seis pacientes (50%) del grupo en el que no se utilizó el tratamiento. Por lo tanto, no se observó diferencia estadística entre los grupos respecto a la tasa de consolidación en el análisis radiográfico. **Conclusiones:** El uso del dispositivo de tracción transversal en este estudio no mostró diferencias significativas con respecto a la tasa de consolidación radiográfica. Además, no existen todavía estudios suficientes sobre la efectiva participación de este dispositivo en la estabilidad de los sistemas de fijación pedicular.

Descriptores: Fusión vertebral; Dispositivos de fijación quirúrgicos; Columna vertebral.

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INTRODUCTION

The use of pedicle screws as a system of spinal fixation is considered safe and effective in the treatment of diseases of the lumbosacral spine, and they have been widely used in the surgical treatment of various spinal diseases including trauma, tumors, degenerative diseases, and deformities. The emergence of these new fixation systems in the 1980s involved the development of new implants and instruments for the purpose of achieving greater mechanical stability.¹

The use of the transverse (cross-link) stabilizer was initially described by Armstrong and Connock² in 1970 for the correction of scoliosis with the Harrington instrumentation. Later, in 1984, Cotrel and Dubousset³ introduced the transverse traction device (TTD) in order to provide the system with greater stability and rotational correction.

Although it has been applied to increase the mechanical stability of the pedicle fixation systems, resulting in higher rates of bone union, its participation in the stabilization of these spinal fixation systems has not been made very clear.⁴⁻⁶

Through an experimental study, Dick *et al.*⁷ concluded that use of the TTD increased the stability of the system. Since then, various biomechanical experimental studies have emerged in the literature showing that use of the TTD provides an increase in stability, primarily in the torsional stability requirement in constructions with pedicle screws.⁷⁻¹²

In a mechanical test, Góes *et al.*¹⁰ demonstrated that the transverse stabilizer increases the mechanical stability of the internal fixator in the frontal plane and specially in the rotational plane, and that the use of two stabilizers provides greater rotational stability of the spinal fixation system.

Wahba *et al.*¹¹ evaluated the biomechanical characteristics in short fixation with and without the TTD in human cadaveric models undergoing unstable burst fractures, and demonstrated that the addition of the TTD to posterior short fixation leads to increased stiffness and a reduction in axial rotation.

We must, however, consider that the effective participation of the device in the stability of the pedicle fixation systems remains uncertain according to the data available in the literature, which has prompted this study. The aim of the study was to evaluate the radiographic outcome of using the TTD in arthrodesis of degenerative diseases of the spine regarding rigid fixation, and the fusion rates of arthrodesis.

METHODS

This study is categorized as a retrospective case series.

The study was conducted at the Department of Orthopedics and Traumatology (Pavilhão Fernandinho Simonsen) of the Santa Casa de Misericórdia de São Paulo in the period from July to September 2011.

After the study was approved by the Ethics in Human Research Committee of the Irmandade da Santa Casa de Misericórdia de São Paulo, SP, Brazil, case number 191/11, the radiographs of the spines of patients were evaluated for spinal arthrodesis due to degenerative pathologies that made use of the TTD. All patients were treated and followed up by the Spine Group of the Department of Orthopedics and Traumatology, School of Medical Sciences, Santa Casa de Misericórdia de São Paulo. In each case, the radiographs were evaluated to identify the presence of rigid segmental fixation, the absence of signs of implant loosening, and the fusion rates.

The surgical approach was performed by means of a median approach, with the patient in the prone position under general anesthesia. All patients received an autologous cancellous bone graft along the transverse processes for the posterolateral arthrodesis and decompression by foraminotomy and laminectomy for the compromised roots. The intraoperative control for the

introduction of pedicle screws was performed by fluoroscopy of the lumbosacral spine, front and profile, and the TTD was used in their respective populations.

Of the 23 patients in this series, 11 patients (48%) used the TTD (Group 1), while 12 patients (52%) did not (Group 2). The inclusion criteria were patients with degenerative lumbar disease undergoing surgical treatment for spinal arthrodesis and fixation with pedicle screws by a posterior approach (2 or 3 levels) with a minimal post-operative follow-up of six months and radiographs of good quality in the anteroposterior, profile, oblique and dynamic views (flexion and extension).

Data collection and radiographs were obtained from the medical records of the Department of Medical Records (SAME), Santa Casa de São Paulo, files from the Spine Surgery Group and during consultations in the Spine Surgery Outpatient Clinic, Department of Orthopedics and Traumatology (Pavilhão Fernandinho Simonsen) of the Santa Casa de Misericórdia de São Paulo.

Regarding sex, 17 patients were females and six were males. The arthrodesis of L4-S1 was carried out in 16 patients (70%), of L3-L5 in three patients (13%), of L1-L3 in one patient (4%), and of L3-S1 (13%) in three patients. (Table 1)

The mean age at surgery in Group 1 was 58 years, with a minimum of 45 years and a maximum of 76 years. In Group 2, it was 53 years, with a minimum of 35 years and a maximum of 79 years. Patients in Group 1 had a mean postoperative follow-up of 16 months, with a minimum of six months and a maximum of 33 months. The patients in Group 2 had a mean postoperative follow-up of 15 months, with a minimum of ten months and a maximum of 24 months. (Table 2)

To characterize the population regarding the radiographic assessment of fusion rates of the arthrodesis, the Linovitz radiographic

Table 1. Descriptive analysis of categorical variables by group.

Variables by group	Group 1		Group 2	
	Total	(%)	Total	(%)
Observation (Levels of arthrodesis)				
Decompression and arthrodesis L1-L3 (2 levels)	0	(0.0)	1	(8.3)
Decompression and arthrodesis L3-L5 (2 levels)	1	(9.1)	2	(16.7)
Decompression and arthrodesis L3-S1 (3 levels)	2	(18.2)	1	(8.3)
Decompression and arthrodesis L4-S1 (2 levels)	8	(72.7)	8	(66.7)
Sex				
Female	9	(81.8)	8	(66.7)
Male	2	(18.2)	4	(33.3)

Source: SAME-ISCMSP.

Table 2. Descriptive analysis of numerical variables by group.

Variables by group	Age		Postoperative time in months	
	Group 1	Group 2	Group 1	Group 2
Mean	58.4	53.3	16.3	15.2
Minimum	45.0	35.0	6.0	10.0
Maximum	76.0	79.0	33.0	24.0

classification was used. (Appendix 1) The review was performed by two spine surgeons properly trained to perform the task, which recorded from the analysis of good quality radiographs in the anteroposterior, profile, oblique and dynamic views.

The Linovitz classification consists of four grades, being Grade 0 (No Fusion), Grade I (Minimal Fusion), Grade II (Moderate Fusion) and Grade III (Solid Fusion).¹³

Once the data were collected, the scales were made compatible to simplify the statistical analysis, classifying patients as lack of fusion (Grade 0 and I) or presence of fusion (Grade II and III).

To compare the variable of consolidation between the two surgical procedures, lumbar fusion surgery with a posterior approach with the use of the TTD (Group 1) and surgery without the use of the device (Group 2), the Fisher's exact test was used. A significance level of 5% was used (p value ≤ 0.05).

RESULTS

In Group 1, one patient was classified as grade 0, three as grade I, six as grade II, and one as grade III. In Group 2, two were classified as grade 0, four as grade I, five as grade II, and one as grade III. (Figure 1A-F – Case 1)

In Group 1, four patients were classified as “no fusion” and seven as “fusion.” In Group 2, six were classified as “fusion” and six as “no fusion.” (Table 3)

According to the results in Table 3, there was no significant difference between groups regarding the rate of consolidation.

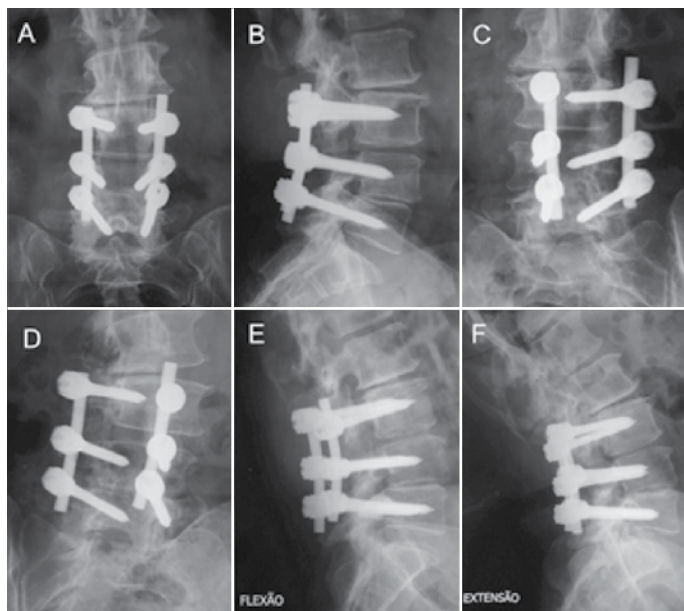


Figure 1. Case 1: (A and B) AP and lateral radiographs at 1 year postoperatively, showing the positions of the pedicle screws at L3, L4, and L5, with no signs of loosening of the material, (C and D) radiographs in oblique view showing the consolidation of the arthrodesis (Classified as Linovitz Grade II), (E and F) dynamic radiographs showing no movement.

DISCUSSION

The use of a transverse traction device was initially used in surgery for scoliosis correction, and improved the system stability. Currently, these devices are routinely used components for connecting the longitudinal rods to the pedicle fixation systems in order to improve their mechanical stability, especially to torsional forces.⁹

Clinical and experimental investigations have indicated that an increase in the mechanical stability of the systems accelerates bone healing and decreases the rate of pseudarthrosis.^{4,8} Thus, we conducted this study in order to indirectly observe whether the use

Table 3. Descriptive analysis of categorical variables by group and the outcome of the tests applied.

Variables by group	Group 1		Group 2		p value
	Total	(%)	Total	(%)	
Consolidation (Linovitz grade)					
Grade 0	1	(9.1)	2	(16.7)	-
Grade I	3	(27.3)	4	(33.3)	
Grade II	6	(54.5)	5	(41.7)	
Grade III	1	(9.1)	1	(8.3)	
Grouped consolidation¹					
No fusion	4	(36.4)	6	(50.0)	0.680
Fusion	7	(63.6)	6	(50.0)	

1: p value of Fisher's exact test.

of this device resulted in a better consolidation rate through the radiographic analysis of the consolidation rate achieved between the different groups with and without the use of a transverse traction device in a pedicle fixation system.

There is no consensus in the literature as how to best analyze and classify the fusion rate. There are many imaging methods to analyze and classify the rate of spinal fusion. The simplest, most low-cost, and probably the most widely used is still plain radiography. However, its accuracy has been reported to be between 60-70%.

In this study, we used the Linovitz classification to assess the rate of consolidation on radiographs between different groups because it is a classification that is easy to apply, and it has good objectivity in its interpretation.¹³

Another important point to be discussed is that the radiographic finding is not always consistent with the findings of surgical exploration. Surgical exploration is the gold standard for identifying bone fusion. Comparative analyses between the radiographic findings and intraoperative in vivo findings suggest that in up to 20% of cases, the radiographic findings underestimate the grade of fusion in relation to the findings in surgical exploration, similar to those found in our study.¹⁴⁻¹⁶

During the analysis of the radiographic classification, we confirmed the difficulty in observing in the radiographs an image of integration of the solid graft and continuous in the region of the transverse process of the vertebrae which is consistent with the results observed in this study.

CONCLUSION

Radiographic evaluation of the use of the transverse traction device (TTD) in vertebral arthrodesis for degenerative diseases showed no significant differences in the rate of consolidation.

The literature is still scarce in studies on the effective participation of the device in the stability of the pedicle fixation systems, requiring further investigation.

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

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Appendix 1. Linovitz classification.

Grade	Category	Continuity percentage	Movement	Description
0	No Fusion	0 to < 25	Present	Discontinuity of the fusion mass with movement
I	Minimal Fusion	25 to < 50	Present	Slight discontinuity of the fusion mass with movement
II	Moderate Fusion	50 to < 75	Absent	Continuity of the fusion without movement
III	Solid Fusion	75 to 100	Absent	Extensive fusion without movement