

EVALUATION OF SYMPTOMATIC DEGENERATIVE LUMBAR STENOSIS WITH PROBABLE DETERMINING FACTORS

AValiação da Estenose Lombar Degenerativa Sintomática com Fatores Determinantes Prováveis

Evaluación de la Estenosis Lumbar Degenerativa Sintomática con Probables Factores Determinantes

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ABSTRACT

Objective: To evaluate degenerative lumbar stenosis in symptomatic patients submitted to surgery and the correlation between probable determining factors. **Methods:** A retrospective descriptive study in which the magnetic resonance images of 73 patients with degenerative stenosis, who underwent surgeries involving 141 levels performed by a single surgeon at the Hospital Ortopédico de Passo Fundo from 2015 to 2018, were evaluated. The patients were stratified by the degree of facet tropism, facet arthrosis, disc degeneration, and operated side, as well as by epidemiological data such as age, sex, etc. Tropism was measured using the Karacan method and evaluated numerically and categorically. Disc degeneration was classified by Pfirrmann and facet arthrosis by Weishaupt. To analyze and obtain the results, the Chi-square test and ANOVA were used with the SPSS statistical program, version 18.0. **Results:** Statistical significance was found in the relationship between facet tropism and disc degeneration ($p=0.026$) at the L4-L5 level. No correlation was found between tropism and facet arthrosis ($p=0.161$) or tropism and the operated side ($p=0.573$). **Conclusion:** The degree of tropism directly influences disc degeneration and greater asymmetries are related to more severe degenerations. Although tropism has not shown a statistically significant correlation with the operated side ($p=0.573$), it is believed that further studies should be carried out on this correlation. **Level of evidence II; Retrospective study.**

Keywords: Intervertebral disc degeneration; Spinal stenosis; Surgical procedure; Magnetic resonance imaging.

RESUMO

Objetivo: Avaliar a estenose lombar degenerativa em pacientes sintomáticos submetidos à cirurgia, analisando a correlação entre fatores determinantes prováveis. **Métodos:** Estudo retrospectivo descritivo, no qual foram avaliados exames de ressonância nuclear magnética de 73 pacientes, totalizando 141 níveis com estenose degenerativa submetidos a tratamento cirúrgico por um único cirurgião do Hospital Ortopédico de Passo Fundo, de 2015 até 2018. Os pacientes foram estratificados de acordo com grau do tropismo facetário, artrose facetária, degeneração discal e lado operado, assim como com dados epidemiológicos como idade, sexo, etc. O tropismo foi aferido pelo método de Karacan e avaliado de forma numérica e categórica. A degeneração discal foi classificada por Pfirrmann e a artrose facetária por Weishaupt. Para análise e obtenção dos resultados foi utilizado o teste do qui-quadrado e ANOVA com o programa estatístico SPSS versão 18.0. **Resultados:** Verificou-se significância estatística na relação entre tropismo facetário e degeneração discal ($p=0,026$) no nível L4-L5. Não foi encontrada correlação entre tropismo e artrose facetária ($p=0,161$) ou tropismo e lado operado ($p=0,573$). **Conclusões:** O grau de tropismo influencia diretamente a degeneração discal, sendo que as assimetrias maiores estão relacionadas a degenerações mais graves. Embora o tropismo não tenha demonstrado correlação estatística significativa com o lado operado ($p=0,573$), acredita-se que deverão ser realizados novos estudos sobre essa correlação. **Nível de evidência II; Estudo retrospectivo.**

Descritores: Degeneração do disco intervertebral; Estenose espinal; Intervenção cirúrgica; Imagem por ressonância magnética.

RESUMEN

Objetivo: Evaluar la estenosis lumbar degenerativa en pacientes sintomáticos sometidos a cirugía, analizando la correlación entre probables factores determinantes. **Métodos:** Estudio retrospectivo descriptivo, en el que se evaluaron los exámenes de resonancia magnética nuclear de 73 pacientes, totalizando 141 niveles con estenosis degenerativa sometidos a tratamiento quirúrgico por un único cirujano en el Hospital Ortopédico de Passo Fundo, de 2015 a 2018. Los pacientes fueron estratificados según el grado de tropismo facetario, artrosis facetaria, degeneración discal y lado operado, así como con datos epidemiológicos como edad, sexo, etc. El tropismo se midió utilizando el método de Karacan y se evaluó numérica y categóricamente. La degeneración discal fue clasificada por Pfirrmann y la artrosis facetaria

Study conducted by the Spine Group of the Hospital Ortopédico de Passo Fundo (HO) and the Faculdade de Medicina da UPF – Passo Fundo, RS, Brazil.

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por Weishaupt. Para analizar y obtener los resultados se utilizó la prueba de chi-cuadrado y ANOVA a través del programa estadístico SPSS versión 18.0. Resultados: Se encontró significación estadística en la relación entre el tropismo facetario y la degeneración discal ($p=0,026$) en el nivel L4-L5. No se encontró correlación entre el tropismo y la artrosis facetaria ($p=0,161$) ni el tropismo y el lado operado ($p=0,573$). Conclusión: El grado de tropismo influye directamente en la degeneración discal, y las mayores asimetrías se relacionan con degeneraciones más severas. Aunque el tropismo no ha mostrado una correlación estadísticamente significativa con el lado operado ($p=0,573$), se cree que deberían realizarse más estudios sobre esta correlación. **Nivel de evidencia II; Estudio retrospectivo.**

Descriptores: Degeneración del disco intervertebral; Estenosis espinal; Intervención quirúrgica; Imagen por resonancia magnética.

INTRODUCTION

Lumbar stenosis is a degenerative disease resulting from the narrowing of the vertebral canal or the intervertebral foramina, which leads to compression of the nerve roots or the thecal sac.^{1,2} It is estimated that 1.7% to 8% of the general population may present clinical symptoms, with increasing prevalence starting in the fifth decade of life and more frequent in the lumbosacral spine and in women.¹

Spondylarthrosis is the most common cause of lumbar spinal stenosis and usually affects individuals over the age of 60. Obesity, family history, discarthrosis, trauma, among others are risk factors for degenerative changes of the discs and posterior elements, favoring spinal canal stenosis.¹⁻⁶

A triarticular complex is found in each spinal segment, formed by the intervertebral disc and the facet joints, constituting a control mechanism for the axial, coronal, and sagittal movements of the lumbar spine. Asymmetry between the angles of the facet joints (right and left) is defined as facet tropism. There is a natural asymmetry between the facet joint angles, however, when the tropism exceeds physiological levels, it may be related to some pathologies.^{4,5}

The choice of treatments depends mainly on the symptoms and on how long they have been present. The therapeutic options range from conservative treatments with physical therapy, changes to lifestyle habits, medications, or cognitive-behavioral therapy to surgical procedures using decompression techniques with or without the need for stabilization by arthrodesis.^{5,6} However, all the factors that influence the pathogenesis of stenosis and the morphopathological aspects of the disease responsible for the prognosis remain uncertain.

The association between facet tropism and disc degeneration, as well as its relationship with other degenerative spinal changes, still present divergent opinions in the literature.¹³ A previous study identified a statistically significant relationship between tropism and the side where the lumbar disc herniation occurs.¹⁶

The objective of the present study was to evaluate degenerative lumbar stenosis in symptomatic patients who underwent surgery with follow-up at the Hospital Ortopédico de Passo Fundo and its correlation with probable determining factors, such as facet tropism on the side operated, disc degeneration, and facet degeneration.

METHODS

A cross-sectional, retrospective study was conducted through the review and analysis of the medical records of 73 patients with degenerative lumbar stenosis who underwent decompression surgery involving a total of 141 levels operated. The collection and analysis of the related factors from the database of the spine surgeon responsible for the procedures was performed by two orthopedists. The study was approved by the Institutional Review Board as protocol number 4.759.804.

Patients with symptomatic degenerative lumbar stenosis surgically treated by a single responsible surgeon at the Hospital Ortopédico de Passo Fundo during the period from January 2015 to December 2018 were included. The medical records consisted of a detailed anamnesis, a description of the surgery, pre- and postoperative anteroposterior and lateral lumbosacral radiographs, in addition to magnetic resonance imaging of the lumbosacral spine in axial and sagittal sections.

Patients under 18 years of age, those with a previous surgery, a history of fracture, tumor, infection, or deformities such as scoliosis,

hyperkyphosis, or malformations were excluded from this study. Medical records without the necessary imaging tests and patients who could not be located or did not agree with the Informed Consent Form were also removed from the sample.

In the present study, facet tropism was analyzed using the Karacan method.¹⁷ Intervertebral disc degeneration was classified by Pfirrmann.¹⁸ Facet tropism was collected as a bimodal numerical and categorical variable (positive and negative), and classified according to Vanharata.¹³ Facet degeneration was classified as per Weishaupt.⁸ Sex, age, and the side submitted to surgical treatment were also evaluated.

To analyze and obtain results, the Chi-squared test and ANOVA were used via the SPSS version 18.0 statistical program. A level of significance of 0.05 ($\alpha=5\%$) was considered and descriptive levels (p) less than this value were considered significant and represented by $p < 0.05$.

RESULTS

Thirty-two of the 73 patients analyzed were male (43.8%) and 41 were female (56.2%). Patient ages ranged from 32 to 81 years, with a mean age of 55.5 years. Twenty-four patients underwent decompression of the right side, 27 of the left side, and 18 patients underwent bilateral decompression.

Level L2-L3 had the smallest sample with 8 patients operated and the mean angulation of the right facets of 29.5° and of the left facets of 31.9°, with mean tropism of -2.4°. Evaluating L3-L4, there was a total of 19 patients operated, with mean right facet angulation of 31.7° and mean left facet angulation of 33.4°, presenting mean tropism of -1.4°. Level L4-L5 had the largest sample, with 59 patients operated and mean angulations of the right and left facets of 40.0° and 40.1°, respectively, with mean tropism of 0.3°. In L5-S1, there was a total of 55 patients operated with a mean right facet angulation of 44.5° and mean left facet angulation of 44.6°, with mean tropism of -0.2° (Table 1).

Seventy-five of the total of 141 operated levels had negative tropism, that is, with facet asymmetry on the left. The remaining 66 levels had positive tropism, that is, with asymmetry on the right.

According to the classification by Weishaupt,⁸ at the L2-L3 level, mild facet degeneration was found in four patients, moderate degeneration in two patients, and severe degeneration in two patients. At level L3-L4, 10 patients had mild degeneration, four presented moderate, and five presented severe degeneration. At level L4-L5, mild degeneration was identified in 15 patients, moderate in 25 patients, and severe in 18 patients. At level L5-S1, mild degeneration was observed in 19 patients, moderate degeneration in 21 patients, and severe degeneration in 13 patients. None of the levels evaluated were classified as degeneration being absent.

According to Pfirrmann's classification,¹⁸ disc degeneration at the L2-L3 level was grade III in four patients, grade IV in two patients, and grade V in two patients. At level L3-L4, two patients presented grade II, four patients had grade III, 12 patients had grade IV, and two patients presented grade V degeneration. At the L4-L5 level, we identified one patient with Pfirrmann's grade I, five patients with

Table 1. Mean Angulations and Tropism

	L2-L3	L3-L4	L4-L5	L5-S1
Right	29.5°	31.7°	40.0°	44.5°
Left	31.9°	33.4°	40.1°	44.6°
Tropism	-2.4°	-1.7°	0.3°	-0.2

grade II, 25 patients with grade III, 23 patients with grade IV, and five patients with grade V degeneration. In L5-S1, grade I was identified in one patient, grade II in nine patients, grade III in 13 patients, grade IV in 16 patients, and grade V in six patients.

Correlation between Facet Tropism and Facet Arthrosis

In the correlation between numeric tropism (in degrees) and categorical degeneration (Weishaupt), the value of statistical significance ranged from $p=0.961$ for L2-L3 to $p=0.614$ for L5-S1. In the analysis of categorical tropism (Vanharata), the level of significance ranged from "absent" at level L2-L3 to $p=0.161$ in L4-L5. Therefore, no statistical significance of correlation was found among the different levels evaluated.

Correlation between Facet Tropism and Disc Degeneration

The ANOVA test identified statistical correlation only at the L4-L5 level ($p=0.026$), but it was not reproducible in the post-hoc test. This result suggests that the greater the facet asymmetry, the greater the disc degeneration, the reciprocal also being true. There was no statistical significance in this correlation at the other levels evaluated.

Correlation between Facet Tropism and the Operated Side

When we evaluated tropism in a continuous quantitative manner, whether categorical (Vanharata) or bimodal categorical (right or left), there was no statistical significance when it was correlated with the side where surgery was required. Fifty-five of the 141 levels evaluated were operated on the same side as the tropism, 32 on the left side and 23 on the right side. Decompression was performed in 50 levels on the side contralateral to the tropism. 28 on the left and 22 on the right. Thirty-six patients underwent bilateral surgery, 19 of them with positive tropism and 17 with negative tropism. There was no statistical significance identified in the analysis using the Chi-squared test ($p=0.573$) (Table 2).

DISCUSSION

The mean age and sex of the patients selected for the present study were like those found in the literature.^{4,9,10,11} The mean angulations of the facet joints and the mean tropism of the different levels evaluated in the study patients were also similar the measurements of other authors.^{4,9,12}

There are still divergent opinions in the literature about the association between facet tropism and disc degeneration. Vanharanta et al.¹³ and Cassidy et al.¹⁴ reported that the correlation between facet tropism and disc degeneration was not significant. However, most other authors disagree with this statement. Noren et al.¹⁵ and other authors,¹⁶⁻¹⁸ concluded that tropism of the facet joint is an important risk factor for the development of disc degeneration, in agreement with Costa et al.,⁴ who showed that the greater the degree of tropism, the greater the degree of disc degeneration. The correlation was also found in the present study but only at the L4-L5 level, perhaps because of the small sample size of the other levels.

Song et al.,¹⁹ evaluating the correlation between the disc and degeneration of the facet joint also observed a significant correlation between facet tropism and disc degeneration. Dai L.Y.²⁰ reported the existence of a significant correlation between the degree of disc degeneration and tropism in degenerative spondylolisthesis. Gao et al.²¹ evaluated tropism with several factors and showed that, for the degenerative lumbar diseases studied, facet tropism also presented

a significant correlation. Kong et al.²² observed a higher incidence of disc degeneration in L4-L5, the level that had the greatest facet tropism. This finding was like the results of our study. Schleich et al.²³ and Cui et al.²⁴ studied the relationship between facet tropism and degenerative disease at the biochemical and histological level. The studies showed that facet tropism was correlated with intervertebral disc degeneration, but not with facet degeneration.^{25,26}

There are still questions about the association between facet tropism and facet arthrosis in the lumbar spine given the scarcity of literature on the subject. However, it is known that facet arthrosis is directly related to age, almost always present after the age of 60,²⁷ while facet tropism is not associated with age²⁸ and can be diagnosed earlier. In the present study, we believed that facet orientation and facet tropism could be associated with lumbar facet osteoarthritis. However, we were not able to statistically prove this relationship, perhaps because the results reflect the small size and heterogeneity of our study sample.

Tisot et al.¹⁶ did not find statistically significant results in their evaluation of the correlation between degeneration of the facet joint and tropism. However, they reported that the most degenerated facet joints were those with greater joint tropism.²⁸ Liu H. X. et al. did not observe a statistically significant association between facet tropism and facet osteoarthritis at level L3-L4 or L4-L5.²⁸ This finding was similar to other studies.^{29,30} Although an association between facet tropism and facet osteoarthritis was found at the L5-S1 level,²⁶ it was not considered statistically significant. According to Weimber et al., the mean facet angle and facet tropism increased caudally. In addition, facet arthrosis increased caudally up to the L4-L5 joint. In this study, facet tropism was a predictor of increased arthrosis in L4-L5 and L5-S1,²⁰ suggesting that the more coronal joints, being subjected to greater load, received greater compression and shear forces.

Information about the correlation between facet tropism and the side operated is still lacking in the literature. Therefore, the present study is the first to attempt to relate facet tropism with the side of the lateral recess stenosis that required surgical decompression. Among the 141 operated levels, there was a slight tendency, though without statistical relevance ($p=0.573$), towards surgery on the side where the tropism was greater. We suspect that with tropism, the facet joint suffers a shearing overload to the side of the asymmetry, promoting osteoarthritis, facet and ligament hypertrophy²⁰ and subluxations, which together with disc degeneration,²⁰⁻²³ potentiate the stenosis and may predict a possible need for surgery. This possible association may be important for early diagnosis and prophylactic measures. The results obtained in the present study may have been impaired by the concomitant analysis of several levels, with slightly different mean facet angles and biomechanics, as a result of them being located in different lumbar lordosis topographies. Future studies of this correlation, with larger samples and level-by-level distinction, especially at the apex of the lordosis, where the shear forces are stronger, will be of great value in trying to reach a more reliable conclusion about that correlation.

CONCLUSION

A statistically significant relationship was found between the degree of tropism and the degree of intervertebral disc degeneration at level L4-L5, suggesting that greater asymmetry is related to more severe degeneration. The relationship between facet tropism and facet arthrosis with the side operated was not statistically relevant at the various levels evaluated.

We believe that the correlation between facet tropism and the side possibly requiring surgery for lateral recess decompression in degenerative lumbar stenosis should be analyzed in more detail in subsequent studies with a greater number of cases.

Table 2. Relationship between the symptomatic side and the operated side.

			Right	Left	Total
Side	Same Side	n	23	32	55
		%	41.8%	58.2%	100%
	Contralateral	n	22	28	50
		%	44.0%	56.0%	100%
	Bilateral	n	19	17	36
		%	52.8%	47.2%	100%
Total		n	64	77	141
		%	45.4%	54.6%	100%

All authors declare no potential conflict of interest related to this article.

CONTRIBUTIONS OF THE AUTHORS: Each author made significant individual contributions to this manuscript. TRA envisioned the project, assisted with the manuscript, oriented the other authors, and accompanied the follow-up of all the cases. VJSL and CDS assisted with the correction of the manuscript and the analysis of the data collected. SMB and MAG collected and analyzed the data and assisted with the writing and bibliographical review of the manuscript. BA, KBD, RCP, PF, SL, VL, BLM, BN, CP, SRM, MT, and MV assisted with the writing and bibliographical review of the manuscript.

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