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SPINAL CANAL SIZE AND SURGICAL OUTCOME IN SPINAL STENOSIS PATIENTS

SPİNAL STENOZLU HASTALARDA SPİNAL KANAL ÇAPI VE CERRAHİ SONUÇLAR

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SUMMARY

Background data: Lumbar spinal stenosis is the most common indication for spinal surgery among patients older than 65 years. The main aim of surgery is to decompress the neural elements. However, radiological proof of decompression and patient outcomes do not always correlate.
Purpose: The main aim of this study is to investigate the correlation between spinal canal decompression and patient outcome, by investigating three different parameters of canal dimensions.

Materials and Methods: 16 patients diagnosed with lumbar spinal stenosis based on MRI findings, who received surgery from the same senior spine surgeon, were included in the study. The surgical outcome was assessed using the Oswestry Disability Index (ODI), prior to surgery and at the first follow-up. Preoperative and postoperative MRIs were compared to assess the degree of surgical decompression. The change in the minimum cross-sectional area, and the AP and transverse diameter of the dural sac were noted. Any correlation between the change in canal dimensions and the patient outcome was evaluated.

Results: Of the three parameters evaluated, only the transverse diameter of the spinal canal showed a significant correlation with improved ODI scores. This correlation still existed after multivariate analysis with regard to normal canal dimensions. The change in cross-sectional area and the AP diameter of the dural sac did not improve the outcome.

Conclusion: Decompression of the transverse diameter of the spinal canal is related to improved patient outcome following spinal stenosis surgery. It is possible that the main reason for discordance between the radiological findings and the neurogenic symptoms in the literature could be that authors were overlooking several parameters when defining stenosis.

Keywords: Spinal stenosis; Oswestry; decompression; spinal canal diameter.

Level of Evidence: Retrospective clinical study, Level III

ÖZET

Geçmiş bilgiler: Lomber spinal stenoz 65 yaş üstü hastalarda en sık spinal cerrahi sebebidir. Cerrahinin ana amacı, nöral dokuları dekomprese etmektir. Fakat, dekompresyonun radyolojik kanıtları ve hasta sonuçları her zaman örtüşmemektedir.

Amaç: Bu çalışmanın amacı, spinal kanal boyutlarının 3 farklı parametresini inceleyerek spinal kanal dekompresyonu ve hasta sonuçları arasındaki ilişkiyi ortaya koymaktır.

Materyal-Metot: Manyetik rezonans (MR) görüntülerinde lomber spinal stenoz saptanması sonrası aynı kıdemli cerrah tarafından opere edilen 16 hasta çalışmaya dahil edildi. Hasta sonuçları cerrahi öncesinde ve ilk kontrol vizitinde doldurulan Oswestry Disability Index (ODI) kullanılarak değerlendirildi. Cerrahi dekompresyonu değerlendirmek için ameliyat öncesi ve sonrası MR görüntüleri karşılaştırıldı. Dural kesenin minimum kesit alanı, AP ve transvers çapındaki değişimler ölçüldü. Kanal boyutlarındaki değişimler ve hasta sonuçları arasındaki ilişki incelendi.

Sonuçlar: İncelenen 3 parametre arasında, sadece spinal kanal transvers çapındaki artışın ODI sonuçlarında iyileşme ile ilişkili olduğu görüldü. Bu ilişki normal kanal çaplarını da istatistiksel değerlendirmeye dahil eden multivaryant analizler sonrasında da devam etti. Kesit alanı ve AP çaplarındaki değişimlerin cerrahi sonuçları etkilemediği görüldü.

Tartışma: Spinal stenoz cerrahisinde spinal kanalın transvers çapının dekompresyonu başarılı hasta sonuçları ile ilişkilidir. Literatürde radyolojik bulgular ve nörojenik semptomlar arasındaki uyumsuzluğun sebebi stenoz tanısı konulurken yazarların belli parametreleri göz ardı etmesi olabilir.

Anahtar kelimeler: Spinal stenoz, Oswestry, dekompresyon, spinal kanal boyutu

Kanıt düzeyi: Retrospektif klinik çalışma, Düzey III

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INTRODUCTION

Lumbar spinal stenosis is a debilitating clinical condition caused by the narrowing of the spinal canal, resulting in diminished space available for neurovascular components[5,14,19]. Symptoms are thought to arise from direct neural compression with conductivity changes, disruption of the vessels supplying the neural element, or an increase in cerebrospinal pressure due to obstruction[5, 20]. Lumbar spinal stenosis is the most common indication for spinal surgery among patients older than[65]. It is usually caused by degenerative spinal conditions, and is likely to increase as the aging population increases[1,3].

A diagnosis of lumbar spinal stenosis needs to be confirmed by radiological findings. MRI is the most sensitive and widely-used imaging modality to detect spinal pathologies. Although symptoms associated with spinal stenosis are well known to clinicians, there has been no agreement on the radiological criteria to define stenosis. Authors use different anatomical landmarks and cut-off values when referring to canal narrowing[9, 15].

Patients with clinical symptoms of spinal stenosis and an unacceptable quality of life for 3–6 months after other treatment modalities have failed are candidates for surgical intervention. The main aim of surgery is to decompress the neural elements[12,20]. It is a general and reasonable assumption that surgical decompression of the neural elements will provide symptomatic relief for spinal stenosis patients. However, the radiological proof of decompression and patient outcomes do not always correlate[7]. Also, many of the patients with radiological evidence of spinal canal narrowing are not symptomatic[1, 19].

The main aim of this study is to investigate the correlation between spinal canal decompression and patient outcome, by investigating three different parameters of canal dimensions.

MATERIALS AND METHODS

This retrospective case control study was performed on 16 patients who received surgery from the same senior spine surgeon. All the patients had symptoms of disabling leg pain or claudication, and were diagnosed with lumbar spinal stenosis based on MRI findings (Figure1). The radiological criteria for a diagnosis of lumbar spinal stenosis were an AP diameter of less than 10 mm at one level at least, or to have a dural sac area of less than 70 mm^2 [15].

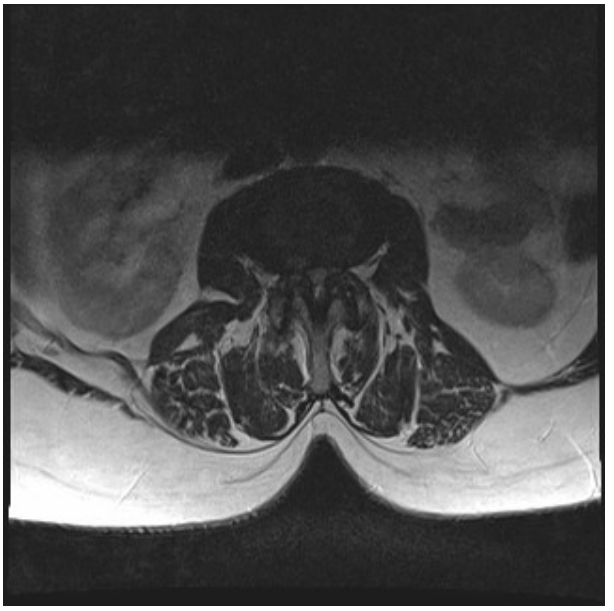

Figure-1. Axial MRI section of a patient with lumbar spinal stenosis

There were 14 female (mean age 65.2 years) and two male (mean age 68.5 years) subjects. We used the Oswestry Disability Index (ODI) for outcome assessment, which is one of the best outcome measure assessment tools for spinal stenosis patients, with excellent test-retest reliability[2].

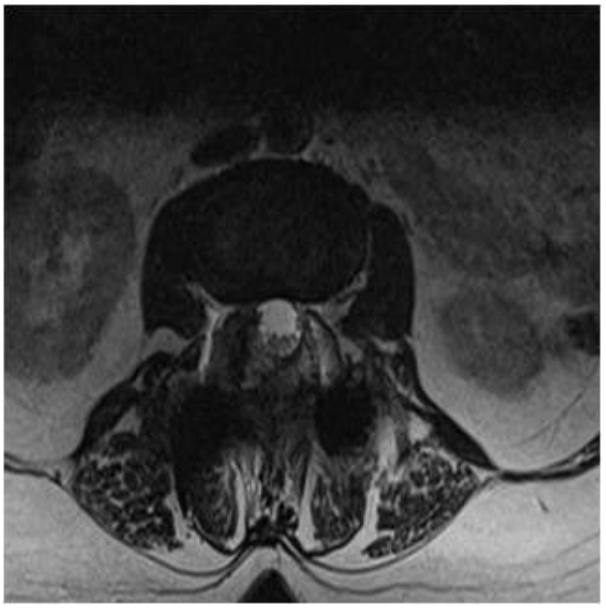

Figure-2. Same level axial view of the patient in figure 1 following decompression and posterior instrumentation.

All the patients answered the validated Turkish translation of the ODI questionnaire prior to surgery. The total score was expressed as a percentage of the maximum score possible. Higher scores pointed to a higher degree of disability[4]. All the patients underwent a central laminectomy, extended laterally, and facetectomy with posterior instrumentation and fusion, to decompress the nerve roots and cauda equina, as necessary. Following discharge from hospital, patients had an MRI in their first follow-up visit, to document the degree of decompression (Figure-2). At the end of the data gathering period, the patients were recalled and asked to complete the ODI questionnaire again. The mean follow-up time was 9.7 months (range: 6.5–12.5 months).

Assessment of MRI findings

The number of stenotic levels, the preoperative and postoperative minimum cross-sectional area, and the AP and transverse diameter of the dural sac were measured. All measurements were made using the Singo VC15A software provided by the manufacturer of the MRI system.

STATISTICS

For statistical analysis, SPSS 12.0 was used. Preoperative and postoperative spinal canal dimensions and ODI scores were assessed using the Wilcoxon test. The Pearson correlation between the change in canal dimensions and change in ODI scores was calculated. For multivariate analysis, with the normal spinal canal dimension of an uninvolved segment as a covariate, MANCOVA (Multivariate Analysis of Covariance) was used. $p<0.05$ was considered significant.

RESULTS

The mean preoperative and postoperative spinal canal dimensions and self-assessment scores are outlined in Table-1. Decompression of all of the spinal canal dimensions was statistically significant. The ODI scores revealed statistically significant improvements in the patient outcome. Only the change in the transverse diameter of the spinal canal showed a significant correlation with improved ODI scores (Table-2). This correlation still existed after multivariate analyses with regard to normal canal dimensions were made.

DISCUSSION

Although symptoms associated with spinal stenosis are well known to clinicians, there is no agreement on the radiological criteria to define stenosis. Authors use different anatomical landmarks and cut-off values when defining canal narrowing[9,15]. A review by Steurer et al. revealed at least ten different parameters when

defining spinal stenosis, including the transverse and AP diameter of the osseous spinal canal, the transverse interfacet distance and the dural sac cross-sectional area. There was no agreement on normal values for these measurements[19]. The AP diameter, defined by Veridest, and the cross-sectional area of the dural sac, remain the most widely used criteria when defining central spinal stenosis[16,21]. The transverse diameter is an overlooked parameter. In a literature review of the quantitative analysis of spinal stenosis, 16 of the 20 studies did not measure the transverse diameter of the osseous or ligamentous canal[19]. We have evaluated the spinal canal by measuring the minimum cross-sectional area, and the AP and transverse diameter of the dural sac. In this study, canal dimensions of the non-stenotic levels were used as co-variates when evaluating a correlation between decompression and patient outcome. Similarly, in the literature, variation of both the canal size and dural sac size led some authors to come up with a definition based on the ratio of the stenotic level to uninvolved segments[9,13].

Table-1. Canal dimensions and patient outcome scores before and after surgery.

	AP diameter	Transverse diameter	Cross-sectional area	ODI*
Preoperative	9.0	11.2	69.5	65.9
Postoperative	15.8	17.3	187.7	22.2
	p<0.05	p<0.05	p<0.05	p<0.05

*ODI: Oswestry Disability Index

As stated in a study by Gunzburg et al., as a given canal size can be stenotic for one individual and not for another, it may be more appropriate to define lumbar stenosis as a condition where the canal is too narrow for the size of dural sac it contains[6].

Table-2. Correlation between the change in canal dimensions and improved patient outcomes.

		Change in ODI score
Change in AP diameter	r	-0.355
	p	0.194
	N	15
Change in transverse diameter	r	-0.563*
	p	0.029
	N	15
Change in cross-sectional area	r	-0.468
	p	0.078
	N	15

*: Significant correlation

One advantage of this study is that it evaluatesthe degree of decompression quantitatively, without referring to cut-off values with poor clinical correlation. Some studies report decreased leg pain and better health scores as the number of stenotic levels increase[17], and many patients with radiological evidence of spinal stenosis remain asymptomatic[10]. The reason for discordance between the preoperative dural sac area and the patient self-assessment questionnaire may be the radiological cut-off value set by Schönström[15,17]. A lack of correlation between the radiological findings and clinical manifestations has led some authors to define this disease from clinical and radiological perspectives separately. Steurer et al. used the definition "buttock or lower extremity pain associated with diminished space for the neurovascular elements in the lumbar spine", while they stated that a second definition of "stenosis of the spinal canal with or without clinical manifestations" would be more appropriate from a radiological point of view[19]. This situation raises the critical question, how

can one assess the adequacy of decompression while a clear definition of stenosis does not exist?

There was a significant improvement in patient outcome following decompression surgery. Decompression of the dural sac area and the AP diameter did not result in improved patient outcome. However, there was a significant correlation between patient outcomes and decompression in the transverse diameter, which is an overlooked parameter. Kovacs et al. stated in their review that results from all the studies consistently favored decompression surgery for the improvement of pain, function and quality of life[12]. Despite the favorable patient outcome following surgical intervention, there is no clearly established relationship between the success of decompression surgery and the radiological proof of decompression[7]. Postoperative radiological evidence of stenosis and patient satisfaction do not correlate[6,11]. Similarly, a qualitative CT analysis on the adequacy of spinal decompression revealed no relationship between the degree of decompression and patient outcomes[8]. Reasons for this discrepancy may be due to the definition of spinal stenosis, which is defined differently by different authors, the definition of adequate decompression, how much of the surgical decompression is evident by radiological tools, or the subjectivity of the patient outcome assessment. The lack of a clear definition of spinal stenosis makes it impossible to define an exact value of decompression. The presence of concomitant degenerative changes make the assessment of surgical outcome and how much of the change is due to the decompression more difficult[7,11].

Since lumbar spinal stenosis is a clinical definition, the main aim of treatment is to provide symptomatic relief rather than maintaining radiological evidence of canal enlargement. Comparison of the pre- and postoperative findings with the changes in clinical functional status may identify predictive factors for surgical management, and help to precisely define radiological stenosis[18].

CONCLUSION

Decompression of the transverse diameter of the spinal canal is related to improved patient outcome following spinal stenosis surgery. This overlooked parameter needs to be assessed carefully by further studies. Evaluation of the effect of the transverse diameter on preoperative neurogenic symptoms, and its relationship with patient assessment, is also necessary. It is possible that the main reason for discordance between radiological findings and neurogenic symptoms may be that authors have been overlooking several parameters when defining stenosis. The results of this study may help to identify predictive factors for surgical management, and help to precisely define radiological stenosis.

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