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The relationship between objective and subjective evaluation criteria in lumbar spinal stenosis

Lomber spinal stenozda objektif ve subjektif değerlendirme ölçütleri arasındaki ilişki

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Amaç: Lomber spinal stenozda (LSS), objektif fonksiyonel değerlendirme, hasta odaklı subjektif değerlendirme ve yaşam kalitesi ölçütleri arasındaki ilişki araştırıldı.

Çalışma planı: Çalışmaya, klinik ve radyolojik olarak LSS tanısı konan 30 hasta (25 kadın, 5 erkek; ort. yaş 62±9; dağılım 41-78) alındı. Ağrı değerlendirilmesi için görsel analog skala kullanıldı. Hastalar ayrıca, iki aşamalı yürüme bandı egzersiz tolerans (YBET) testi, Short Form–36 (SF-36) yaşam kalitesi sorgulama anketi, Oswestry dizabilite indeksi (ODİ) kullanılarak değerlendirildi. Objektif bir fonksiyonel değerlendirme yöntemi olan YBET testi ile hasta odaklı subjektif değerlendirme yöntemleri olan SF-36 anketi ve ODİ, yaş ve ağrı şiddeti arasındaki ilişki araştırıldı.

Sonuçlar: Hastaların YBET testinde 1.9 km/saat hızdaki fonksiyonel evreleri arasında, ODİ, SF-36'nın fiziksel komponent skalası, yaş ve tercih ettikleri hızlar açısından anlamlı farklılık saptandı ($p<0.05$). Bu farklılıkların dördüncü fonksiyonel evreden kaynaklandığı görüldü ($p<0.01$). Hastaların YBET testi evreleri ilerledikçe ODİ ve SF-36 fiziksel komponent skalası skorları kötüleşmekteydi. Tercih edilen hızda yapılan YBET testinde, tercih edilen yürüme hızıyla sadece SF-36'nın fiziksel komponent skalası arasında pozitif ve ODİ arasında negatif bir ilişki ($p<0.05$) olduğu görüldü. ODİ ile SF-36 anketinin fiziksel komponent skalası arasında anlamlı negatif ilişki vardı ($p<0.05$).

Çıkarımlar: Fonksiyonel kapasiteyi objektif olarak belirleyen YBET testi, hasta odaklı subjektif değerlendirme yöntemleriyle de ilişkili bir testtir. Lomber spinal stenozda tedavi kararını verme aşamasında, hasta odaklı subjektif testlerin yanı sıra YBET testi de yararlı olabilir.

Anahtar sözcükler: Egzersiz testi; egzersiz toleransı; dizabilite değerlendirmesi; lomber vertebra; lumbosakral bölge; yaşam kalitesi; spinal stenoz/komplikasyon.

Objectives: We evaluated the relationship between functional objective and patient-based subjective assessments and quality of life in patients with lumbar spinal stenosis (LSS).

Methods: Thirty patients (25 females, 5 males; mean age 62±9 years; range 41-78 years) were prospectively studied. All were diagnosed as having LSS by clinical and radiological evaluations. Pain was assessed by a visual analog scale. The patients were evaluated by two-staged treadmill exercise tolerance (TET) test, SF-36 health status survey, and Oswestry Disability Index (ODI). The relationships between the TET test, which is an objective functional assessment, and patient-based assessments (SF-36 and ODI), pain and age were investigated.

Results: There were significant differences between the functional grades of the patients at the speed of 1.9 km/hour with respect to ODI scores, the physical component scale of SF-36, age, and the preferred speed of the patients ($p<0.05$). These differences emerged from the fourth functional stage ($p<0.01$). Oswestry disability scores and the physical component scores of SF-36 worsened in parallel with the stages of the TET test. The preferred speed of the patients at the TET test was positively correlated with the physical component scores of SF-36 and negatively correlated with Oswestry disability scores ($p<0.05$). There was a negative correlation between the physical component scores of SF-36 and Oswestry disability scores ($p<0.05$).

Conclusion: The TET test used to determine the functional capacity seems to be correlated well with subjective patient-based assessments. This objective tool, when combined with subjective assessments, may be helpful in the evaluation and treatment of patients with LSS.

Key words: Exercise test; exercise tolerance; disability evaluation; lumbar vertebrae; lumbosacral region; quality of life; spinal stenosis/complications.

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Lumbar spinal stenosis (LSS) is one of the major causes of back pain, leg pain and disability particularly in the elderly,[1] usually as a result of the degenerative changes.[2] In degenerative LSS, chronic compression of the cauda equina occurs due to degenerative hypertrophic lesions and ligamentum flavum hypertrophy, particularly during 60-70 years of age, which in turn results in back pain.[3] Symptoms such as dysesthesia, paresthesia, hyposthesia, motor function loss, back and leg pains and neurogenic claudication are observed due to lumbosacral root dysfunction.[4] The neurogenic claudication, a major cause of disability, manifests itself while walking and it relieves while seating, and it is defined as pain, numbness, paresthesia and cramp in one or two legs.[5] These symptoms typically increase while walking, exercising and standing, and they are relieved with the flexion of the lumbar spine.[6]

Increasing number of spinal imaging methods allows easier diagnosis. The diameter of the canal and neural roots can be imaged by magnetic resonance imaging, computed tomography and myelography.[2,7] However, imaging methods do not provide any information about the functional status.

Lumbar spinal stenosis can be conservatively or surgically treated.[3,5,8] Findings of the physical examination and functional status of the patient are critical in making the decision for treatment. For subjective assessments, Short Form-36 (SF-36) and Oswestry Disability Index (ODI), and for objective assessments, diameter of the spinal canal, ambulation capacity and treadmill exercise tolerance (TET) test can be used. A correlation was found between age, degree of narrowing, ambulation capacity and TET, and it was indicated that TET is an objective and reliable criterion of the functional status.[6] However, the association between the subjective symptoms and narrowness of the spinal canal diameter is still unknown. The present study evaluated the relationship between the functional objective assessments and patient-based subjective assessments and the criteria for quality of life in patients with lumbar spinal stenosis.

Patients and method

The prospective study included thirty patients (25 females, 5 males; mean age 62±9 years; range 41-78 years), who were clinically and radiologically diagnosed with LSS and whose treatment regimen was defined accordingly. All patients were evaluated before the treatment by a physiatrist for the following exclusion criteria, and the pain was evaluated by a 10-point visual analog scale, and the physical examination was carried out using a two-staged TET test.

Exclusion criteria: Presence of conditions that may be contraindicated for treadmill exercise tolerance test, history of unstable angina pectoris during recent rest, untreated cardiac arrhythmia, decompansated congestive cardiac failure, atrioventricular block, acute myocarditis or pericarditis, critical aortic stenosis, severe hypertrophic obstructive cardiomyopathy, uncontrolled hypertension, acute systemic disease.

The disability of patients was evaluated using the ODI, which is a questionnaire consisting of 10 questions, where each item is scored on a 0-5 point scale, and the higher the score is the greater the disability, and for which the validity and reliability in Turkish have been already established.[9] The quality of life was evaluated using the SF-36 Questionnaire, which is a test consisting of 36 questions that measure 8 domains; physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. In this test for which the validity and reliability have been already established for Turkish society, the results are summed under two groups; physical and mental health components, and they are defined with scores ranging from 0 to 100. The higher scores indicate an improved level of health.[10]

Treadmill exercise tolerance test protocol

All patients exercised on the treadmill with a 0° ramp inclination for pre-treatment quantitative assessments. The test was completed in two speeds; 1.9 km/hr, and a speed preferred by the patient himself/herself. Each patient had a rest before the test and between the two stages for half an hour. The time to onset of first symptom, total ambulation time and nature of symptoms (leg pain, back pain and generalized fatique) were recorded. The test was ended after 15 minutes or when severe symptoms occured. Severe symptoms were defined as conditions, which prevent ambulation during normal daily life. The exercises were performed while the patients were kept upright without holding any support dur-

ing the test. None of the patients were encouraged to walk more. A separate functional phasing was performed according to their ambulation time in two stages. Based on this protocol, the speed of the first stage was selected as not to reveal cardiovascular symptoms, but LSS symptoms and neurogenic claudication. Studies have shown that the protocol is sensitive in determining the functional level, and that any tests longer than 15 minutes have no effect on revealing the symptoms.[11,12]

The functional grades were as follows depending on the ambulation time in both stages: Grade 1– 15 minute ambulation without symptoms; Grade 2– 15 minute ambulation with symptoms; Grade 3– ambulation between 5 and 15 minutes; Grade 4– ambulation less than 5 minutes.

Presence of any difference in SF-36 Questionnaire, ODI, age, time to onset and severity of pain between the grades of the TET test, which is an objective functional assessment tool, was investigated using the Kruskal-Wallis test. Based on the treadmill exercise tolerance test, one patient was included in Grade 2 as there was only one patient in Grade 1, and $p<0.05$ was considered significant. The Mann-Whitney U-test was conducted in order to determine to which group the difference belonged to in the rating of the treadmill exercise tolerance test. For multiple comparisons, Bonferoni adjustment was carried out, and $p\leq0.01$ was considered significant. The relationship between the preferred speed for the treadmill exercise tolerance test, ODI, SF-36 Questionnaire, age and time to onset of symptoms was investigated using the Spearman test; and $p<0.05$ was considered significant.

Results

Data is shown at Table 1. In the TET test, there were significant differences between the functional grades of the patients at the speed of 1.9 km/hr in ODI (p=0.03), physical component scale of the SF-36 Questionnaire (p=0.004), age (p=0.01) and patient's preferred speed (p=0.003) (Table 2). No significant difference was found in pain (p=0.71), time to onset (p=0.42) and mental component scale of the SF-36 Questionnaire (p=0.52). As the functional grades of the patients are advanced in the TET test, the scores in the physical component scale of the SF-36 Questionnaire got worsened (Table 2). In the multiple comparisons carried out in order to determine the grade these differences were resulting from, a significant difference was found between the Grades 2 and 4 in the physical component of the SF-36 Questionnaire (p=0.006), ODI (p=0.01) and the patients' preferred speed in the TET test (p=0.001). There was also a significant difference between the Grades 3 and 4 in respect to the age (p=0.006). The inter-grade differences were resulting from the 4th functional grade (Table 2).

Table 1. Data of the cases

	Mean ± SSNumber (n=30)
Average age	62±9
Gender	
Male	5
Female	25
Time to onset (month)	113.9±102.6
Pain (Visual analog scale)	7.2±1.7
TMETT 1.9 km/hr	
Grade 1	1
Grade 2	4
Grade 3	7
Grade 4	18

TET Test: Treadmill Exercise Tolerance test

When the relationship between the walking speed in the TET test and age, pain, time to onset, ODI and SF-36 was analyzed, it was observed that there was only a positive correlation between the walking speed and the physical component scores of the SF-36 (r=0.51, p=0.004) and a negative correlation with the ODI scores (r=-0.54, p=0.002). A significant negative correlation was found between the physical component scores of the SF-36 Questionnaire and the Oswestry disability index (r=-0.70, p=0.000); but, no significant relationship with the mental component scale (r=-0.20, p=0.27). The age was significantly negatively correlated with the physical component scale of the SF-36 Questionnaire (r=-0.48, p=0.008) while the pain was significantly positively correlated with the ODI (r=0.65, p=0.000). Also, a significant negative correlation was found with the physical component scale of the SF-36 Questionnaire (r=-0.50, p=0.006). Time to onset had no significant relationship with any of the parameters (p>0.05) (Table 3).

Table 2. Comparison of the patients by Kruskal-Wallis Test in respect to age, time to onset, SF-36 and Oswestry Disability Index as per the functional grade of the treadmill exercise tolerance test

	Median	Distribution	Kruskal-Wallis (*p*)	Multiple comparison (*p*)
Age (year)				
Grade 2	65	53-67.5	0.01	Grade 3 and 4, p=0.006
Grade3	57	51-59		
Grade 4	64	59-73.2		
Pain (Visual analog scale)				
Grade 2	7	5-8.5	0.71	
Grade 3	7	5.5-8		
Grade 4	8	6.3-8		
Time to onset (month)				
Grade 2	60	24-105	0.42	
Grade 3	120	108-180		
Grade 4	72	6.3-8		
SF-36 physical component scale				
Grade 2	36.8	37.4-48.2	0.004	Grades 2 and 4, p=0.006
Grade 3	34.9	29.5-36.8		
Grade 4	25.7	21.7-30.8		
SF-36 mental component scale				
Grade 2	33.9	28.2-50.4	0.52	
Grade 3	36.4	25.8-46.1		
Grade 4	38.9	33.7-51.2		
Oswestry Disability Index				
Grade 2	38	34-53	0.03	Grades 2 and 4, p=0.01
Grade 3	54	52-72		
Grade 4	66	59.5- 76		
Preferred speed on the treadmill				
Grade 2	2.9	2.5-3.1	0.003	Grade 2 and 4, p=0.001
Grade 3	1.8	1.2-2.0		
Grade 4	1.5	0-2		

P<0.05 was considered significant for the Kruskal-Wallis test

Discussion

Recently the effects of diseases on the quality of life of the patients have been recognized more and more, and increasing the quality of life is becoming an important target, too. That means, quality of life has been used as a criterion in the follow-up of patients before and during the treatment. Lumbar spinal stenosis may have a negative impact on the quality of life due to related disabilities and pain. Studies on the spinal stenosis also deal with the effect of the treatment methods on the quality of life and functional level. However, it has been suggested that patient-based assessment systems may be insufficient in determining the treatment method or monitoring the outcome, particularly in differential diagnosis from the psychogenic disorders, therefore it should be supported by more objective assessment methods. Another issue, based on these requirements, is the correlation of the objective and patient-based subjective assessment systems. The present study evaluated the relationship between the SF-36 Questionnaire, which measures the quality of life, among the subjective assessment methods and ODI and the TET test, providing an objective assessment.

We found a significant correlation between the treadmill exercise tolerance test (1.9 km/hour) and the ODI ($p<0.05$). The neurogenic claudication, the most characteristic symptom of the lumbar spinal stenosis restricts the walking distance and daily life activities of the patient, and is responsible from a major part of the disabilities. In recent studies, the

Table 3. Relation between the Oswestry disability index, SF-36, age, pain, time to onset and TET test

	Age	Pain (VAS)	Time to onset	PFS	ODI	PCS	MCS
ODI							
r	0.26	0.65**	-0.07	-0.54**	1	-0.70**	-0.20
p	0.17	0.000	0.73	0.002	–	0.000	0.27
PCS							
r	-0.48**	0.50**	-0.14	0.51**	-0.7**	1	-0.13
p	0.008	0.006	0.48	0.004	0.000	–	0.49
MKS							
r	0.2	-0.27	0.07	-0.24	-0.2	-0.13	1
p	0.27	0.15	0.72	0.18	0.27	0.49	–
PFS							
r	-0.25	-0.29	-0.02	1	-0.54**	0.51**	-0.25
p	0.17	0.12	0.92	–	0.002	0.004	0.18
Age							
r	1	0.06	-0.38	-0.25	0.26	-0.48**	0.2
p	–	0.74	0.05	0.17	0.17	0.008	0.27
Pain (VAS)							
r	0.06	1	0.02	-0.29	0.65**	-0.50**	-0.27
p	0.74	–	0.94	0.12	0.000	0.006	0.15
Time to onset							
r	-0.38	0.01	1	-0.02	-0.07	-0.14	0.07
p	0.05	0.94	–	0.92	0.73	0.48	0.72

**p<0.01 and p<0.05 were considered significant; PCS: physical component scale of the SF-36 questionnaire; ODI: Oswestry disability index; MCS: mental component scale of the SF-36 questionnaire; VAS: Visual analog scale; PFS: Patient's preferred speed during the treadmill exercise tolerance test carried out at preferred speed.

neurogenic claudication and amputation capacity have been assessed using the TET test, and the patients are functionally classified according to the amputation periods. The treadmill exercise tolerance test has been recognized as a test objectively reflecting the reliable and functional status in LSS.[13,14] The Oswestry disability index is a patient-based subjective test recommended for the assessment of the functional disability associated with LSS.[15] The relation we observed between these two tests is consistent with the clinical outcomes.

In a prospective study on patients with neurogenic claudication, who were surgically treated, Yukawa et al.[6] measured the functional status by the TET test and correlation with the ODI; and found that TET test reveals neurogenic claudication, and it is sensitive in revealing the symptoms, and it is correlated with the patient-based subjective criteria. Furthermore, they found a correlation between the TET test and the age, extent of narrowing, and ambulation capacity, and stated that it will be beneficial to decide on the treatment and use during the follow-up.

It has been demonstrated that the quality of life has been affected from the chronic spinal diseases, and the SF-36 Questionnaire, particularly the physical component provides valuable information and can be used during the follow-up.[16] Similarly, in our study, we found that there was a correlation between the functional grade of the patient and only the physical component scale of the SF-36; however, no significant relation was found with the mental component scale. Furthermore, it was found that the patients' preferred speed was increased and the ODI scores were improved as the physical component scale of the patients was increased. There was a relation between the disability scores of the patients and the physical component scale scores of the SF-36. As expected, increased disability also had an impact on the physical component scores of the quality of life.

No significant relation was found between the functional grade determined at the treadmill exercise tolerance test and the level of pain, which suggests that the functional limitations and disability were associated with neurological findings rather than the pain.

The TET is an objective and easy-to-use test reflecting the functional status of the patient, associated with the patient-based subjective tests in the lumbar spinal stenosis. We believe that the TET test can be beneficial as well as the patient-based subjective tests in the assessment, selection of treatment and follow-up stages of the treatment.

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