A COMPARATIVE ANALYSIS OF STATIC BALANCE BETWEEN PATIENTS WITH LUMBAR SPINAL CANAL STENOSIS AND ASYMPTOMATIC PARTICIPANTS

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ABSTRACT

Objective: The aim of this study was to assess static balance in patients with lumbar spinal canal stenosis who qualified for surgical decompression of associated neural structures and compare them with asymptomatic participants.

Methods: This case-controlled study evaluated a sample of 50 patients with spinal canal stenosis (stenosis group) and 48 participants with no history of clinical symptoms of back pain. Static balance was assessed by conducting quantitative analysis of balance reaction parameters in quiet standing with the eyes closed.

Results: Higher values were observed in total length of center of pressure (COP) path, length of COP path in the anterior-posterior plane, mean amplitude of COP projection in the anterior-posterior plane, maximal amplitude between the 2 most distant points in the anterior-posterior plane, mean COP velocity, and sway area marked by the moving COP in the stenosis group compared with the asymptomatic group.

Conclusions: This study showed statistically significant differences in static balance parameters between patients with spinal canal stenosis compared with the asymptomatic group. (J Manipulative Physiol Ther 2014;37:696-701)

Key indexing terms: *Postural Balance; Lumbar Vertebrae; Spinal Stenosis*

P ostural stability is a fundamental aspect of motor control that allows individuals to sustain and maintain desired body positions.[1] The assessment of balance function is one of the most common functional tests used under clinical conditions.[2,3]

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The efficiency of a body balance system is influenced by various factors, including age and neurologic dysfunction,[4] past cerebrocranial injuries,[5] and locomotor system disorders.[6] The spine plays an essential role in maintaining balance, and spinal disorders affect postural control in an upright position.[7] One of the most common spinal disorders is lumbar spinal canal stenosis.[8] Stenosis is a syndrome of various etiologies, whose clinical manifestations include back pain, sciatica, and neurogenic claudication. The morphologic manifestation of stenosis is a narrowing of the spinal canal, intervertebral foramina, and lateral recesses.[9–14] In addition to a decline in physical function with aging are symptoms and/or signs of stenosis impair balance.[10] Lumbar spinal canal stenosis leads to the trunk bending forward, distortions in motor coordination, and an asymmetrical load on the lower limbs. The relevant literature does not explain to what extent stenosis of the spinal canal and intervertebral foramina impairs proprioception and deteriorates postural stability.[15] The sway of the center of pressure (COP) is measured with the help of force plates, and various parameters are then calculated from the COP trajectory.[2]

The aim of this study was to assess static balance in patients with lumbar spinal canal stenosis who qualified for surgical decompression of associated neural structures and compare them with asymptomatic participants.

Table 1. *Biometrical Characteristics of Participants and Statistical Data*

Variable	Stenosis Group				Asymptomatic Group				Mann-Whitney U	Z	P	Effect Size
	Mean	Median	Min	Max	Mean	Median	Min	Max				
Age (y)	52.74	56.67	26	74	56.24	57.11	40	69	1088.5	−1.115	.265	0.112
Height (cm)	168.90	165.58	152	193	163.78	165.00	156	183	1091.0	−1.099	.272	0.110
Body mass (kg)	79.53	76.25	58.2	121.5	74.09	70.77	49.9	94.4	1020.0	−1.586	.113	0.159

METHODS

The study population consisted of 50 patients (34 women and 16 men) with lumbar spinal canal stenosis (stenosis group). The asymptomatic group consisted of 48 participants (36 women and 12 men) with no history of clinical symptoms of back pain.

Table 1 presents biometrical and statistical data. No biometrical differences were found between the analyzed groups.

The inclusion criterion for the stenosis group was spinal canal stenosis confirmed clinically and by imaging methods (radiograph and magnetic resonance imaging [MRI]), accompanied by neurogenic claudication. All patients were qualified to receive surgical treatment. The following exclusion criteria were used: lack of consent to participate in the study, other serious pathologies of the locomotor system, and having undergone surgery within a year prior to the study. The inclusion criteria for the asymptomatic group were no neurologic and motor system disorders that affected body posture, and no symptoms of spinal degenerative disorders in clinical examination and radiograph.

All patients were hospitalized at the Department of Orthopedic Surgery, Center of Postgraduate Medical Education. They expressed informed consent to participate in the study. The consent to conduct the study was obtained from the Bioethic Commission at the Medical Department of the University of Rzeszów. The tests were conducted from January to April, 2013.

To collect the necessary data, the participants were tested for static balance (ie, quantitative analysis of their balance reaction parameters in quiet standing with eyes closed). This test is an indicator of static body control and allows for accurate measurements of the participant's ability to control their center of gravity and balance without visual feedback. The goal of the test was to hold the static position of the body for the duration of the test through anterior-posterior (AP) and medial-lateral (ML) movement of the feet and ankles. The patients stood with both feet placed parallel to each other, hip width apart, on the plate of the "CQ Stabtensometric" platform. The measurements were taken in two 30-second-long samples. The equipment analyses the COP movement in the AP plane (or y-axis) and in the ML plane (or x-axis). The plates of the equipment were placed 2 m away from the corner of the room. The patients were instructed to assume a relaxed standing posture, facing the equipment. Then, they were instructed to step onto the platform and keep the head straight, eyes closed, and arms along their body, and the balance quantification assessment was performed. The higher the variance of COP measurements, the higher values indicating more severe problems in maintaining balance. All tests were conducted by the same well-trained person. The parameters for analysis were chosen on the basis of generally accepted norms.

The measurements for those in the stenosis group were taken at least 1 day prior to their surgery. During the tests, the patients were not under the influence of analgesic or sedative medicines. The balance parameters analyzed are listed in Figure 1.

Information from the literature revealed that postural control in patients was more significantly influenced by the visual system when compared with a control group.[15,16,4,17] As such, we expected larger changes in postural stability with the eyes closed compared with the eyes open. Therefore, we only analyzed parameters for the test with the eyes closed.

Statistical Analysis

Descriptive statistics and mean parameter values were calculated. The differences in means were calculated using Student t test, with statistical significance set at $P < .05$. Because of the relatively small sample size and the lack of normal distribution (confirmed by a Kolmogorov-Smirnov test) with most of the variables, statistical analysis was performed using nonparametric methods. The distributions were characterized by arithmetic mean, median, and range values. The significance of differences between groups was assessed by a Mann-Whitney U test.

RESULTS

Analysis of the collected data revealed statistically significant differences between parameters in patients with spinal canal stenosis (stenosis group) and the asymptomatic group ($P < .05$). Table 2 presents the collected data.

We observed higher values of total length of COP path, length of COP path in the AP plane, mean amplitude of COP projection in the AP plane, maximal amplitude between the 2 most distant points in the AP plane, mean COP velocity, and sway area marked by the moving COP in the stenosis group (Table 2). Maximal amplitude between the 2 most distant points in the ML plane and