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Postural stability disorders in rural patients with lumbar spinal stenosis

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Abstract

Introduction. Hard work in farming may lead to lumbar spinal stenosis, and consequently, to pain. The pain and neurological disorders may lead to disability and postural disorders.
Objective. The aim of the presented study was to analyse postural stability and its correlation with functional disability of patients with lumbar spinal stenosis living in rural areas.
Materials and methods. The study population consisted of 30 rural patients with lumbar spinal stenosis; mean age: 51.40 (±12.92); mean BMI: 28.60 (±3.77). The control group consisted of 30 rural inhabitants without spinal disorders. Postural stability was tested on the Biodex Balance System. The patients were also evaluated according to the ODI, the Rolland-Morris disability questionnaire, and VAS.
Results. The mean results of the patients studied were as follows: 49.37 (±17.39) according to ODI, 15 (±6.19) according to the Rolland-Morris disability scale, and pain intensity of 7 (±1.93) according to the VAS. The following statistically significant differences were found: the mean balance index result was 1.8 (±1.88) and 0.64 (±0.41) in the control group. The mean centre of mass deviation in the A/P plane was 1.39 (±1.88) and 0.46 (±0.41) in the control group. The mean centre of mass deviation in the M/L plane was 0.8 (±0.51) and 0.32 (±0.22) in the control group. The balance in the studied population correlated significantly with the Rolland-Morris disability questionnaire and the VAS.
Conclusions: 1) Serious disability was found in rural patients with spinal stenosis. There was a statistically significant correlation between the disability and postural stability disorders. 2) Most of the patients (84%) were overweight. 3) Postural stability disorders were statistically significant for both the stability index and the A/P plane deviation.

Key words
Postural stability, biodex balance system, spinal stenosis, farmers, Oswestry Disability Index, Rolland- Morris Scale, VAS

INTRODUCTION

Lumbar stenosis is an abnormal narrowing of the spinal canal within the structures that form the spinal canal, or a change in their shape that causes restriction in the capacity of the canal and to the diameter of the intervertebral foramina [1]. Stenosis may be caused by degenerative disorders of intervertebral joints, nucleus pulposus hernia, thickening of flavum ligaments, degenerative spondylolysthesis, or a congenital narrowing. Stenosis may also be caused by such diseases as inflammation, tuberculosis or spine cancer and metastasis. Stenosis manifests itself in back pain radiating to the lower limbs and neurogenic claudication. The patients try to relieve the pain in the spine and the limb to which the pain is radiating. A postural disorder follows: it is characteristic that the patient demonstrates diminished lumbar lordosis and – at times – sagittal deviation, usually in the contralateral site (opposite side to the pain felt). The pain results in various degrees of disability, postural disorder and neurological claudication. Compression of one or several nerve roots leads to neurological disorders, namely, sensory disorders or muscle weakening, depending on the level of the spine affected. The above-mentioned disorders should correlate with postural stability disorders of various degrees in the patients group.

In considering the above, it is of importance whether the proprioception has been retained. The proprioception is responsible for the joint position sense (JPS) and the joint motion sense (JSM). A functional effect of unimpaired proprioception is the ability to move, maintain a posture, balance, and walk correctly [2, 3].

OBJECTIVE

The objective of the presented study was to analyse postural stability, disability and pain intensity in rural patients with lumbar spinal canal stenosis.

MATERIALS AND METHOD

The study population consisted of 30 patients with lumbar stenosis, prospectively qualified for surgery by a spinal surgeon experienced in decompression of lumbar spinal stenosis. The surgeon was not aware of the aim of this study.

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The consent of the Ethical Board at the Józef Piłsudski University of Physical Education in Warsaw was obtained. The study was performed between January – June 2012. The mean age of the patients was 51.40 (±12.92), mean BMI – 28.60 (±3.77). 11 patients (36.6%) were obese, with BMI over 30. Only 5 patients (16%) had normal weight, with BMI lower than 25. The study group covered 20 females (66.7%) and 10 males (33.3%). The males were more likely to refuse to participate in the study. The rural patients examined had worked in a bent position while lifting heavy weights, also when performing additional non-farming work activities. This may have led to the development of degenerative spine disorders.

The patients were diagnosed with spinal canal stenosis or recess stenosis: 19 of them (63.3%) at the L4-L5 level and 11 of (36.7%) at the L5-S1 level. The clinical examination was confirmed with an MRI or CT scan. The spinal pain radiated to the left lower limb in 12 patients (40%), and to the right lower limb in 18 patients (60%).

The patients who were qualified for tests on the biodex balance platform had the symptoms of spinal canal stenosis, neurogenic claudication at walking less than 200 meters, neurological disorder (degree IV or less in Lovett scale), or showed no improvement despite physiotherapy.

The criteria for excluding patients were: lack of patient consent to participate in the study, and spondyliolysthesis or other pathological abnormalities of the spine.

After obtaining patient consent the patients were tested on the Biodex Balance System platform. All the tests were conducted by the same, well-trained person. The goal of the test was to hold the unstable platform in a level position for the duration of the test through anterior-posterior and medial-lateral movement of the feet and ankles. The patients were told to stand still in an upright position with the eyes open and the feet placed parallel at hip distance away from each other. A screen was positioned at eye level, so the patients could follow their movement and to prevent them from assuming an improper posture. The screen depicted the area of the platform represented by four concentric zones labeled A, B, C, D and four parts marked I, II, III and IV. The postural stability test consisted of three measurements. Each measurement was taken at the level 12 of platform stability (1 = least stable, 12 = most stable) and at intervals: 20 seconds of testing, and 10 seconds break. Three stability indices were calculated as follows: anterio-posterior stability index (APSI) – represented the variance of platform displacement in degrees, from level, for motion in the sagittal plane; medio-lateral stability index (MLSI) – represented the variance of platform displacement in degrees, from level, in the frontal plane; overall stability index (OSI), as a sum of the first two, was defined as the variance of the platform displacement from level in all motions during the test, measured in degrees, where a greater value indicates more displacement and less balance stability. These three scores are the standard output of the dynamic balance test. The higher variance, the higher the score indicating more severe problems in maintaining balance. It was the angular deflection of the patient's center of pressure. All tasks were conducted three times in order to ensure reliability and the best result was analyzed.

The patients were also evaluated according the subjective disability scales: the Oswestry Disability Index (ODI), the Rolland-Morris disability questionnaire and the Visual Analogue Scale (VAS).

The clinical control group consisted of 30 rural inhabitants without spinal disorders, physiotherapy students of Department of Physical Education and Sport in Biała Podlaska. Their mean age was 24.67 (±7.63) years, mean BMI – 20.57 (±1.75). There were 16 females (53.3%) and 14 males (46.7%) in the group.

Statistical analysis. In the cases where the independent (explanatory) variables had dichotomy nature/ were dichotomous, the Student's t-test was applied for independent trials, while the equality of variance was controlled with the use of Levene's test. In the cases of independent variables measured on at least rank level, the correlation was established by the Kendall rank correlation coefficient. In both cases, bilateral statistical significance was the basis.

RESULTS

Balance was tested on the Biodex Balance System platform. The mean balance result for the studied population was 1.8 (±1.88), and for the clinical control group – 0.64 (±0.41). This difference was statistically significant.

The mean centre of mass deviation in the Anterior/Posterior plane (A/P plane) was 1.39 (±1.88) in the studied population and 0.46 (±0.41) in the control group. This difference was statistically significant.

The mean centre of mass deviation in the Medial/Lateral plane (M/L plane) was 0.8 (±0.51) in the studied population and 0.32 (±0.22) in the control group, a difference that was not statistically significant.

Patient disability was evaluated according the ODI, one of the most common instruments used for the evaluation of chronic disability [4, 5]. The results were added and presented as a percentage, where 0% means full ability and 100% full disability [6]. The mean result of the studied population was 49.37 (±17.39), which means that the subjective evaluation of disability as expressed by the patients was within the range of serious disability.

The Rolland-Morris disability questionnaire revealed a mean patient disability of 15 (±6.19).

The VAS scores revealed a mean pain level of 7 (±1. 93). According to the VAS, 10 is the worst pain a patient can endure, and 0 means no pain at all.

The balance in the studied population correlated significantly with the Rolland-Morris disability questionnaire and the VAS. The more serious the disability, the worse the patient score (Tab. 1, Tab. 2).

The centre of mass deviation in the Medial/Lateral plane also revealed a correlation with the VAS scores that was statistically significant.

DISCUSSION

Main findings. This is the first prospective study to discuss postural stability disorders in rural patients admitted to hospital because of lumbar spinal canal stenosis. Tests revealed that the condition affects the balance, and the more serious the disability, the more the balance is affected.

Lumbar back pain in rural patients. Solecki, in his study [7], has discussed the causes of chronic lumbar pain radiating

Table 1. Correlation (Tau b Kendall coefficient) between disability on Rolland-Morris scale and postural stability: overall (OSI), anterior-posterior (APSI) and medio-lateral (MLSI)

NON-PARAMETRIC CORRELATIONS

Correlations					
			OSI	APSI	MLSI
Tau b Kendalla	Rolland-Morris	Correlation coefficient	.394**	.394**	.197
		Significance (bilateral)	.003	.004	.148
		N	30	30	30
	Oswestry	Correlation coefficient	.007	.056	.065
		Significance (bilateral)	.957	.679	.627
		N	30	30	30

**. Correlation significant at 0.01 (bilateral)

Table 2. Correlation (Tau b Kendall coefficient) between disability on Rolland-Morris scale, Oswestry between standard deviations of stability indexes (overall – OSI- sd, anterior-posterior – APSI-sd and medio-lateral – MLSI-sd)

Correlations					
			OSI- sd	APSI-sd	MLSI-sd
Tau b Kendalla	Rolland-Morris	Correlation coefficient	.295*	.311*	.227
		Significance (bilateral)	.027	.019	.087
		N	30	30	30
	Oswestry	Correlation coefficient	.231	.148	.115
		Significance (bilateral)	.079	.260	.380
		N	30	30	30

*. Correlation is significant at 0.05 (bilateral)

to one or both lower extremities in more than 90% of farmers who both cultivate plants and breed animals. An interesting study on the influence of vibration on spinal pain was conducted by Milosavljievic et al. [8]. They analysed the condition of 130 farmers in New Zealand and noticed that spinal pain was related to the vibration felt while riding quads. Also, Solecki [9] determined that whole body vibration may cause lumbar spine pain.

A bent position while working may lead to chronic back pain in farmers [10, 11]. Dong et al. [12] observed lumbar, knee and shoulder pain in farmers who worked in greenhouses. This kind of work requires a bent spine position, likely to lead to degenerative disc disease. Kneeling and squatting results in long-term compression of the knee joint cartilage, while work with one's arms stretched forward leads to overstrain of the shoulder joint muscles. The development of overstrain disorders of the spine and of the peripheral has been confirmed by [13]. Postural stability and lumbar pain

The uneven distribution of the body mass (two-thirds of the mass are located in two- thirds of the body height above ground) leads to a high degree of postural instability. Therefore, the postural stability system has to constantly correct the position in order to maintain balance [2]. The position refers to the placing of each body segment depending on the gravity vector. This is expressed in angle measurement in relation to the vertical line. The balance refers to the dynamics of the position the body takes in order to avoid falling down. The balance depends on the inert forces affecting the body and the inert characteristics of body segments.

The control of the body in space is enabled by the combined information of the proprioceptive receptors located in the joints and muscles of the locomotor system, and information from the vestibular and ocular system. Several factors may disturb proprioception. These may be: age [14], degenerative disorders [15], pain, tiredness, excessive heat, excessive cold and joint fluid [16]. In the case of degenerative disorders, the proprioception changes may result from inflammation of tissues surrounding the joints. The main symptom of postural instability are balance disorders resulting in the patient falling down.

The studied patients presented many factors that disturbed their postural stability. They suffered from severe spine pain (VAS scores exceeded 7/10) radiating to one or both lower extremities. Their functional ability was severely reduced and correlated with postural stability disorders. The more severe the disability, the worse the stability of the patient. The studied patients were still at an economically productive age (mean age – 51.40 (±12.92) years), which was alarming since they could not perform hard work.

The above-mentioned issue has been noted by other authors. Spinal pain predisposed people towards taking sick leave [16].

Another disturbing phenomenon related to the studied patients was their considerable weight – their mean BMI amounted to 28.60 (±3.77).

The difference between the control group and the studied population regarding the mean centre of mass deviation in the A/P plane may be related to muscle weakening. L4-L5 level disorders weaken the foot dorsal flexors, while L5-S1 level disorders weaken the foot plantar flexors. Both muscle groups control movements of the foot in the A/P plane.

Others have studied balance in patients with spinal canal stenosis. Suda et al. [17] have analysed the walking disorders of 60 patients with lumbar stenosis and neurogenic claudication. They measured the ground force reactions, time and distance dependent factors, and walking style dependent factors (symmetry, repeatability, fluency, rhythm). They observed several disorders, beginning from the moment the patient started the walking test. The disorders subsided after surgical treatment. Similarly, walking disorders in patients with spinal canal stenosis have been observed by Kerrigan et al. [18].

Gill [19] and Jo [20] have observed that proprioception worsens in patients with spinal pain. On the contrary, Sung and Ham [21] have concluded that there are no changes in the standing position in subjects with and without stenosis. They did notice, however, that males had better stability results than females.

Constraints of the study. The presented study was conducted on a limited group of patients; it was prospective, and there was no opportunity to plan a randomized study. It is quite difficult to conduct a survey among patients with severe walking disability – they had a walking distance limited to 200 meters. Also, standing erect – necessary for conducting the study – provokes low back and leg pain. Lumbar spinal stenosis is a disease that mainly affects women, due to heavy work and domestic duties. That is the reason there were more women in the researched group.

The control and examined groups consisted of the same number of participants, but differed in age and BMI. The aim of the presented study was to compare posture stability of a symptomatic group with the control asymptomatic group. Because age, the BMI and hard work are the risk factors for lumbar spinal disorders, younger persons with no history low back pain were selected as the control group.

Value of the study. The presented study is the first in the Polish literature analysing a group of patients with homogenous disorders. It includes a homogeneous group of patients, all of whom had severe disability due to spinal stenosis. With lengthening life expectancy, the incidence of spinal canal stenosis will increase, which means an increase in the number disabilities and operations, especially among the hard working population. Patient therapy should be aimed at the improvement of the postural stability of patients to prevent falls and the resulting bone fractures which, in turn, may lead to hospitalization.

CONCLUSIONS

1. Serious disability was found in rural patients with spinal stenosis. There was a statistically significant correlation between the disability and postural stability disorders.
2. Most of the patients (84%) were overweight or obese.
3. Postural stability disorders in patients with lumbar spinal stenosis were statistically significant for both the stability index and the A/P plane deviation.

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