Postural stability disorders in rural patients with lumbar spinal stenosis

Aleksandra Truszczyńska1,2,3, Olaf Truszczyński4, Kazimierz Rąpała2,5, Elżbieta Gmitrzykowska1, Adam Tarnowski5

1 Prof. A. Gruca Independent Public Research Hospital, Otwock Department of Orthopaedic Surgery, Centre for Postgraduate Medical Education, Otwock, Poland
2 Department of Physical Education and Sport, Biała Podlaska, Academy of Physical Education, Warsaw, Poland
3 Jozef Piłsudski University of Physical Education, Physiotherapy Department, Warsaw, Poland
4 Military Institute of Aviation Medicine, Warsaw, Poland
5 University of Social Science, Warsaw, Poland

The study population consisted of 30 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 spondylolysis, 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.

Address for correspondence: Aleksandra Truszczyńska, Józef Piłsudski University of Physical Education in Warsaw, Faculty of Rehabilitation, Marymoncka St. 34, 00-968 Warsaw
e-mail: aleksandra.rapala@wp.pl
Received: 17 November 2012; accepted: 12 March 2013
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 spondylolysis 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: antero-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.

**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...
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 Milosavljevic 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 may cause lumbar spine pain.

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].

**Correlations**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>OSI</th>
<th>APSI</th>
<th>MLSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolland-Morris</td>
<td>Correlation coefficient</td>
<td>.394**</td>
<td>.394**</td>
</tr>
<tr>
<td>Significance (bilateral)</td>
<td>.003</td>
<td>.004</td>
<td>.148</td>
</tr>
<tr>
<td>N</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

**Correlations**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>OSI-sd</th>
<th>APSI-sd</th>
<th>MLSI-sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolland-Morris</td>
<td>Correlation coefficient</td>
<td>.295</td>
<td>.311</td>
</tr>
<tr>
<td>Significance (bilateral)</td>
<td>.027</td>
<td>.019</td>
<td>.087</td>
</tr>
<tr>
<td>N</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

**Correlations**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>OSI</th>
<th>APSI</th>
<th>MLSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oswestry</td>
<td>Correlation coefficient</td>
<td>.231</td>
<td>.148</td>
</tr>
<tr>
<td>Significance (bilateral)</td>
<td>.079</td>
<td>.260</td>
<td>.380</td>
</tr>
<tr>
<td>N</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

* Correlation is significant at 0.05 (bilateral)

**Correlations**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>OSI</th>
<th>APSI</th>
<th>MLSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation coefficient</td>
<td>.231</td>
<td>.148</td>
<td>.115</td>
</tr>
<tr>
<td>Significance (bilateral)</td>
<td>.079</td>
<td>.260</td>
<td>.380</td>
</tr>
<tr>
<td>N</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

**Correlations**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>OSI</th>
<th>APSI</th>
<th>MLSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation coefficient</td>
<td>.394**</td>
<td>.394**</td>
<td>.197</td>
</tr>
<tr>
<td>Significance (bilateral)</td>
<td>.003</td>
<td>.004</td>
<td>.148</td>
</tr>
<tr>
<td>N</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

**Correlations**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>OSI</th>
<th>APSI</th>
<th>MLSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation coefficient</td>
<td>.394**</td>
<td>.394**</td>
<td>.197</td>
</tr>
<tr>
<td>Significance (bilateral)</td>
<td>.003</td>
<td>.004</td>
<td>.148</td>
</tr>
<tr>
<td>N</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

**Correlations**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>OSI</th>
<th>APSI</th>
<th>MLSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation coefficient</td>
<td>.394**</td>
<td>.394**</td>
<td>.197</td>
</tr>
<tr>
<td>Significance (bilateral)</td>
<td>.003</td>
<td>.004</td>
<td>.148</td>
</tr>
<tr>
<td>N</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>
lumbar spinal disorders, younger persons with no history of 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 homogeneous 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 of 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.

**Acknowledgements**
The report was prepared as a part of a research project at the Faculty of Physical Education and Sport in Biała Podlaska. The Jozef Pilsudski University of Physical Education in Warsaw DS. 167 financed by the Ministry of Science and Higher Education.

**REFERENCES**