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Case Report

Training of flexion and rotation of the lumbar-sacral spine based on Kinetic Control

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ABSTRACT

Introduction: Various methods of rehabilitation are used at present; among which Kinetic Control is constituting as one of the concepts and according to which it is important to test the patients during functional training in order to determine their preferred direction of motion and weak links in the kinetic chain. Functional training takes into consideration the direction of motion, motor work of muscle units and endurance of dysfunctional muscle groups.

Aim: To choose tests which will determine muscular imbalances on the basis of Kinetic Control and to determine how the sitting position and stability of the lower limb improve functionally.

Case study: The study presents a 43-year-old patient with history of left knee joint injury in 2001. In 2006, the patient suffered from severe sciatic neuritis radiating to the left lower limb. The rehabilitation programme which lasted for a year included rehabilitation of the lumbar spine.

Results and discussion: Prior to the therapy, the patient was examined according to the concept of Kinetic Control, i.e. tests were performed in order to determine the direction of motion as well as muscular imbalances. After the training period, the tests showed functional improvements of the sitting position and the stability of the left lower limb when performing everyday motor activities.

Conclusions: (1) The performed tests, which were part of functional training, showed abnormalities in the direction of motion and muscular imbalances. (2) An improvement occurred in the sitting position and in the stability of the left lower limb.

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1. Introduction

Dysfunction syndromes of the lumbar spine constitute a social problem which affects teenagers at the age of puberty, students and adults.[1,2] Factors, which contribute to the pathologies of the intervertebral disc, are analyzed by many researchers.[3–6] At present, various rehabilitation methods are applied to deal with the problem, and one of them is the concept of Kinetic Control, in which it is important to test the patient during functional training in order to determine their preferred direction of motion and weak links in the kinetic chain. What is important during the training is the function of muscles, which stabilize locally as well as the function of global stabilizers and global mobilizers.[3,7–10] A precise selection of exercises increases the effectiveness of the therapy and the stability of trunk muscles in patients with chronic low back pain.[11–13]

2. Aim

The aim of this study is to choose tests which will determine muscular imbalances on the basis of Kinetic Control and to determine how the sitting position and stability of the lower limb improve functionally.

3. Case study

The study presents a 43-year-old patient with history of left knee joint injury in 2001. As a result of the injury while skiing the collateral ligaments of the left lower limb were damaged. At present, the patient reports ligament instability in the left knee joint. In 2006, an episode of sciatic neuritis radiating to the left lower limb occurred. In the MRI, the left posterolateral herniated nucleus pulposus at the L5–S1 was demonstrated. The rehabilitation programme to improve the condition of the lumbar spine lasted for a year. The therapy at the beginning included the application of passive extension movement and the training to strengthen the muscular corset in low positions. At present, the patient does not report any pain in the lumbar-sacral spine, yet reports paresthesias to the left foot, mainly in the exterior forefoot and in the hallux. The neurological examinations showed no symptoms of deficits, yet the examined reflexes were symmetrical for both lower limbs. The patient is motorically active, and regularly practises aerobic sports (skiing, swimming, and aerobic exercises).

4. Results and discussion

4.1. *Tests preceding therapy according to the Kinetic Control concept*

4.1.1. *Determining the direction of motion*

The control test of the lumbar spine flexion and the external rotation of the lower limb in the side lying position. The patient was lying on the side, which is not tested. Her task was to perform external rotation of the hip joint with adduction of the left lower limb at the flexed knee and hip joint and with proper control of the direction of flexion and rotation of the lumbar spine. The test was performed correctly (Fig. 1).

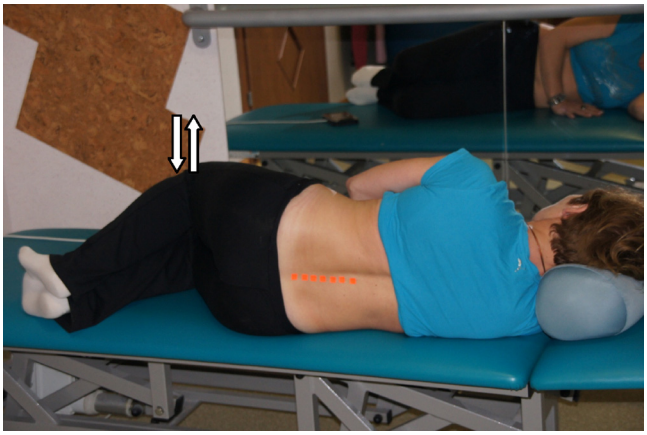

Fig. 1 – The control test of the lumbar spine flexion and the external rotation of the left lower limb in the side lying position.

The control test of the lumbar spine flexion and rotation dissociation of the lower limb by extension of the knee joint in the sitting position. It was found that the direction of motion as well as the quality of movement for both lower limbs was performed correctly. As a result of the test, difficulties keeping the left lower limb extended were noticed in the sitting position, with the impaired quality of motion. The range of motion was correct (Fig. 2).

The control test of lower limbs rotation in the standing position with the neutral pelvic position. The test consisted of performing a rotation of knee joints when the pelvis was stable in its neutral position. During the test it was observed that the quality of motion was impaired when rotating lower limbs; the range of the performed motion was normal. The patient was assessed in the frontal as well as sagittal plane (Fig. 3).

In order to plan a comprehensive training once the control dysfunction of the direction of motion was assessed, tests of

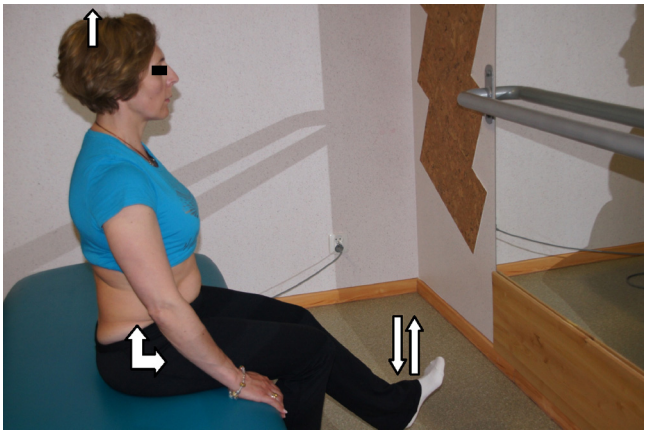

Fig. 2 – The test of the lumbar spine flexion control and rotation dissociation of the lower extremity through extension of the knee joint in the sitting position.

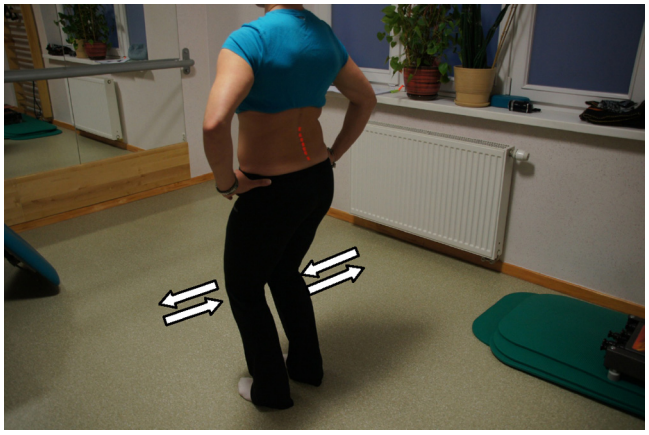

Fig. 3 – The control test of lower limbs rotation in the standing position in the neutral pelvic position – the saggital plane.

Fig. 5 – The test of range of motion and elasticity of ischiocrural muscles in the back lying position.

chosen muscle groups were planned, with an analysis of normal length, elasticity and concentric and eccentric work of the analyzed motion pattern.

4.1.2. *Determining muscular dysfunctions*

The test of maintaining range of motion and gluteus muscles endurance in the face down lying position on the rehabilitation table. The patient was instructed to vertically lift her lower limb flexed in the knee joint at 90° angle. The motion should be performed in one line, without compensation in the hip, knee or ankle joint. The test consisted of two repetitions, 15 s each. The patient performed the test correctly for both limbs (Fig. 4).

The test of range of motion and elasticity of ischiocrural muscles in the back lying position. The patient was asked to perform active extension of each lower limb with extension of the knee joint. The elasticity of ischiocrural muscles was assessed at the extension of the knee joint without compensation in the hip and knee joint. The patient performed the test incorrectly for the left lower limb (Fig. 5).

The test of oblique muscles endurance in the back lying position. The patient lifted her torso twisting it at 30°, with the lumbar spine on the ground and posterior pelvic tilt. The test consisted of two repetitions, 15 s each. The patient performed the test correctly (Fig. 6).

The test of range of motion and endurance of the iliacus muscle and the anterior part of psoas muscle in the sitting position. The test consisted of two repetitions, 15 s each. The patient was asked to lift her lower limb starting from the hip joint when sitting with neutral pelvic position. During the test the observed motion was that of the lower limb positioned in the line of the anterior iliac spine without rotation of the lower leg and lateral displacement of the trunk in the frontal plane. The patient performed the test incorrectly for both lower limbs (Fig. 7).

4.2. *Review of the tests*

The tests performed by patient contributed considerably to planning functional training. The tests determining the

Fig. 4 – The test of maintaining range of motion and endurance of gluteus muscles in the face down lying position on the rehabilitation table.

Fig. 6 – The test of oblique muscles endurance in the back lying position.

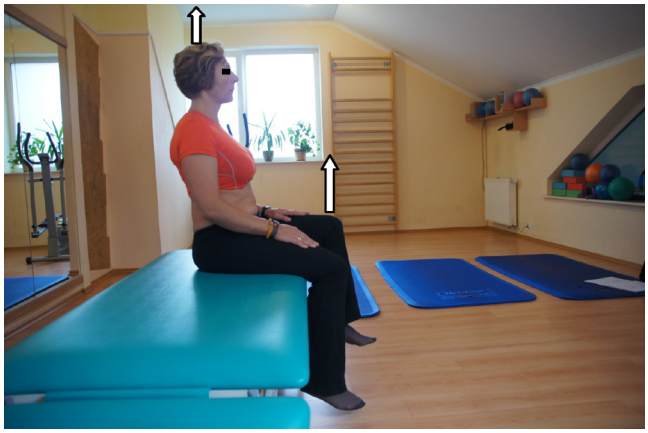

Fig. 7 – The test of range of motion and endurance of iliacus and the anterior part of psoas muscle in the sitting position.

direction of motion showed impaired quality of the analyzed motion in the sitting and standing positions. Larger impairments were observed in the function of the tested muscle groups. The test presented in Fig. 4 showed insufficiency of gluteus maximus. When analysing a similar subject matter,[14] one of the researchers recommended exercising gluteus maximus and improve the elasticity of ischiocrural muscles in a systematic functional training.[14] Examination presented in Fig. 5 showed lack of normal range of motion in the left lower limb and weak elasticity of ischiocrural muscles. Hyperactivity of these muscles may influence the stability of pelvic-hip complex, since contraction of biceps muscles of the thigh may have effect on the sacrotuberous ligament.[15] The analysis of abdominal muscles showed normal function, including superficial muscles which worked in internal range of motion. Such results are in agreement with those of research earlier conducted by Hodges and Silfies.[3,16] The researchers proved that the transversus abdominis starts working earlier, and obliquus and rectus abdominis join at the same time but later, and they do not stabilize the spine in the same way. Good endurance of abdominal muscles prevents spine problems.[3,16] The test presented in Fig. 7 showed insufficiency of the iliacus and the anterior part of psoas muscle. The function of flexion and extension of the lumbar spine depends on the distribution of muscle parts and may take place without engagement of abdominal muscles.[17] The stability of the L5–S1 is ensured by the anatomical structure of L5 vertebra (its large costal processes) and strong ilio-psoas muscle (additionally also by the ventral sacro-iliac ligament).[1,18] The analysis of the tests made it possible to plan an individual functional training.

The planned training comprised two stages. In the first one, for six weeks the function training was performed in order to improve the direction of motion. The performed tests constituted a set of exercises repeated in everyday training. The test of the lumbar spine flexion and the external rotation of the left lower limb in the side lying position (Fig. 1) was applied for two weeks in order to maintain and improve the correct direction of motion, with 20–30 repetitions performed twice a day. At the same time the lumbar spine flexion control training (Fig. 2) was introduced, 20 repetitions each twice a day. Since the third week, the training was performed only in the sitting and standing position. In the standing one, the test of lower limbs rotation was applied in a cycle of 20 repetitions. In the seventh week, as the second stage of the training, therapy based on the muscular imbalance tests was introduced in order to diminish muscle dysfunction. The tests, which the patient performed incorrectly, were an introduction to the planned therapy. The training was performed once a day in 10 repetitions (6–10 s each), until first symptoms of fatigue in the trained muscle group appeared and with no compensation of the motion pattern. The training progressed with introduction of one more set of the same number of repetitions. This training plan was followed for four weeks. After this period, it was observed that the paresthesias in the forefoot and hallux of the left foot diminished. The functional training in the analyzed clinical case resulted in a quick functional improvement with only a little engagement on the part of the patient. It indicates that it is worth analysing such cases and attempting to improve the functional condition of patients irrespectively of how long ago they sustained the injury.

5. Discussion

There are various methods of rehabilitating patients with low back pain. One of the most known ones consists in implementing exercises, which strengthen superficial abdominal, gluteus and back muscles.[19] Most of the modern methods which help to bring back stability and improve function of the lumbar spine as well as limbs are based on choosing directional motion, motor control, and selecting deep and superficial muscles engagement, learning a motion pattern as well as on individual training burdens and similar rules are met by the concept of Kinetic Control.[20–24] The functional tests help to determine a specialist training direction on the level of local and global muscles. Learning new motion patterns requires focus, engagement and systematic training on the part of the patient. Minimizing the training burdens in the first stage makes it possible to more easily create neural-muscular pathways and recruit motor units to replace the pathological patterns. Such a work should result in an integrated pattern of optimal motor function. The functional stability depends on the integrated local and global muscle work.[11,21–23,25–27] Chronic pain and motor deficits are related to impairments of motor control and control from the central nervous system and concern a considerable group of patients.[28] Hodges in his communications states that the motor control training is more important than the training aimed at strengthening trunk muscles.[3,22] Among Polish researchers, such an approach was confirmed as viable by Kuszewski.[15] In turn, Vliet in his communications shows that alternations of tasks at an early therapy stage allow patients to develop a more effective model of motor learning. It is worth remembering that in patients with low back pain the cortex maps of creating neural-muscular pathways are changeable, while neurplasticity is still in the research phase.[29–31] Key thinks that deep muscles constitute a stabilizing foundation of the spine, yet global muscles make it possible to maintain a stable posture and

control movements. If the whole system, local and global, works in an integrated manner, man moves more effectively and without pain.[29,30]

In order to propose universal conclusions it is worth extending training programmes by conducting detailed research projects in a wide group of youth and adults with spine pain syndromes.

6. Conclusions

1. The conducted tests showed impairments in the direction of motion and muscle imbalance and they were part of a functional training.
2. Improvement in the sitting position and better stability of the left lower limb occurred as a result of the undertaken training.

Conflict of interest

None declared.

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