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EFFECT OF NEURAC THERAPY ON PLANTAR PRESSURES DISTRIBUTION AND THE CENTER OF GRAVITY OF THE HUMAN BODY

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Abstract: Nowadays, the pathophysiological posture is a problem for a large part of the population, which leads to a deterioration in the quality of life as a result of functional disorders of the human musculoskeletal system. The aim of the presented article is to point out the effectiveness of movement therapy for the correction of the pelvic position and subsequent adjustment of the body posture, which is evaluated by a change in the distribution of plantar pressures as well as the position of the center of gravity projection. Observations were made on three subjects who reported pain in different areas of the body as a result of incorrect body posture. Input and control measurements were performed on a baropodometer, and Neurac movement therapy in the Redcord system was applied between the individual measurements. The individual exercises were chosen specifically with regard to affect the specific muscle groups. After evaluating the measured data, it can be stated that the selected movement therapy has a significant effect on the correction of pathophysiological position, which is also demonstrated by changing the distribution of plantar pressures, adjusting the position of the center of gravity projection and also significantly eliminating painful symptoms and increasing movement comfort.

1 Introduction

With functional changes of the pelvis, there are postural changes, a deviation of the projection of the center of gravity and a change in the distribution of plantar pressures, which leads to overload and subsequent pain in various areas of the body [1]. Elimination of pelvic dysfunctions can be accomplished through manual medicine and the active Neurac movement method. The purpose of the manual therapy is to deal with special diagnostic and therapeutic procedures that are used for treatment of musculoskeletal reversible functional disorders [2][3]. These are special manual techniques that analyze and localize movement disorders in the area of peripheral and intervertebral joints. The chosen techniques of the individual mobilization that are applied by physiotherapist are determined by the diagnosis, the direction of motion restriction and the type of particular joint. These techniques are used to relieve pain and to mobilize limited movement caused by a reversible functional disorder of the joint or muscles associated with the particular joint [3][4].

The Neurac® (Neuromuscular Activation) treatment method is based on special therapeutically accurate designed exercises in Redcord® devices [5].

The aim of these exercises is to eliminate pain and restore functional motion patterns through high levels of neuromuscular stimulation, while improving muscle harmony and focusing on the cause of problems. These are exercises with bodyweight in all planes and in the unstable environment through the rope [5].

2 Methodology

The measurement was performed in cooperation with physiotherapist Jaroslav Dulina, who has been working in the field of rehabilitation for 15 years. He worked with clients with various degrees of physical ability in a facility equipped with a Redcord system.

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The Redcord Therapy System was performed on subjects that went through a basic 5-second static test on a baropodometer and were diagnosed with a functional change in the pelvic position using inspection and palpation. The initial examination was followed by a warm-up consisting of 6 exercises. Selected exercises were performed lying on the back and abdomen (Figure 1) in 3 series of 10 repetitions. Subsequently, they completed another static test and exercise in the Redcord system for 20-30 minutes. Each subject followed the physiotherapist's instructions under his constant supervision.

The aim of the selected exercises was to increase the neuromuscular control and functional stability of the pelvis in the hip area as well as in the torso area. The exercises focused on the dorsal, ventral and lateral myofascial chains. The indications were impaired neuromuscular control, impaired functional stability, decreased or painful range of motion, fatigue, stiffness, discomfort or pain [5].

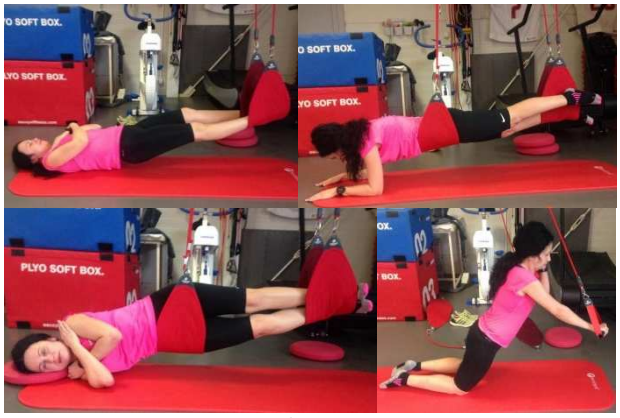


Figure 1 Exercises performed in the Redcord system

After completing the exercises in the Redcord system, a static output test was performed on a baropodometer, following the methodology as in the previous measurements (Figure 2).

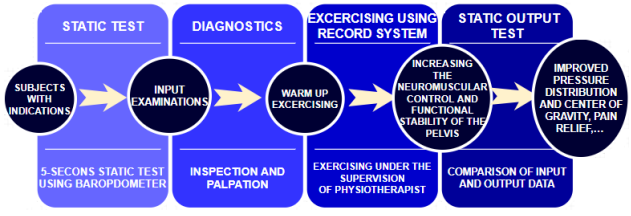


Figure 2 Measurement procedure

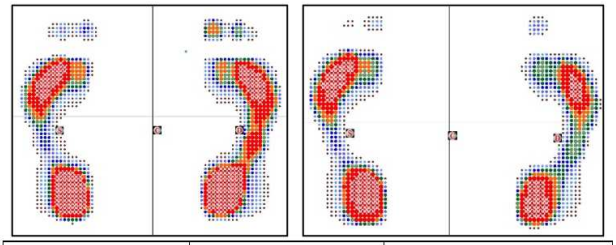
Pedobarometry use computer-processed data from pressure sensors, which inform about the load on the foot during standing or other activities. The pressure sensors have the shape of matrix that measure the force acting on the element of the matrix. Sensors allow accurate real-time sensing and analysis of pressure distribution on the foot in a standing position (static test) and during walking (dynamic test). During the static test, overloaded areas are located, including the projection of the maximum compressive force on the soles of the feet. The distribution of the load between the left and right lower limb is evaluated and compared areas of the support are measured between the forefoot and the hindfoot part of each limb. The position of the center of gravity and the center of the loading forces on the left and right lower limbs are also recorded.

3 Results

3.1 Subject 1

A 43-year-old man, an active motorcycle rider who regularly practices 2-3 times a week. In the past, a professional football player who ended his career due to surgery of groin. The subject had persistent knee problems and in the past he had a broken vertebrae, collarbone and arm, and underwent spinal surgery.

An initial measurement on a baropodometer revealed an overload of the middle part of the right foot, which was related to pain in the left groin. After the warm-up, the contracted muscles relaxed. Subsequently, the subject completed 4 exercises in the Redcord system in the period of 25-30 minutes, during which he had some problems with their correct exercising. It was not necessary due to use of auxiliary straps or ropes. In the output measurement, the test was run without the subject's knowledge, so that the results were not affected by his active correction.



	Before exercises		After exercises	
Frontfoot	Sx	Dx	Sx	Dx
Surface (cm^2)	75,25	80,25	68,75	65,50
Load (%)	22,4	24,5	25,3	22,5
Ratio HF (%)	49,1	45,1	50,0	45,5
Hindfoot	Sx	Dx	Sx	Dx
Surface (cm^2)	79,50	92,25	69,75	75,22
Load (%)	23,2	29,9	25,3	26,9
Ratio HF (%)	50,9	54,9	50,0	54,5
Total	Sx	Dx	Sx	Dx
Surface (cm^2)	154,75	172,50	138,50	140,50
Load (%)	47,3	52,7	49,6	50,4

Figure 3 Static test of the 1st subject (before therapy, after movement therapy)

It is noticeable (Figure 3) that the position of the center of gravity has been adjusted and an even distribution of the body weight has been ensured. On the right foot, the midfoot part is correctly lightened, which was overloaded before the exercise. From a biomechanical point of view the overload of midfoot part could cause limitation of the function of the longitudinal arch during walking. The

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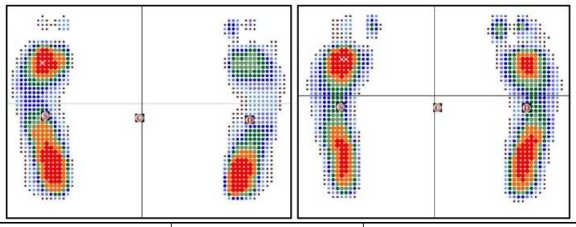
pressure distribution between the right and left lower limbs also clearly improved.

3.2 Subject 2

A 40-year-old female subject with left hindfoot pain, who has never played professional sports. She has a sedentary job and started running actively 2 years ago. It runs 4-5 times a week for 1-1.5 hours at a free pace.

The initial static test confirmed the overload of the left leg, especially in the heel area, complete relief of the forefoot, rotation of the pelvis from left to right as well as rotation of the pelvis downwards on the left side. As a result of this overload, there were increased impacts in the area of the Achilles tendon caused by the minimal support of the 1st and 2nd fingers and the complete absence of the support of 3-5 fingers. Subsequently, the subject proceeded to the exercise in the Redcord system, where 4 exercises were performed in 4 series of 10 repetitions. The subject was able to perform the exercises only after changing the suspension point, which caused the extension of the exercise and it took about 30-35 minutes. Subsequently, an output static test was performed.



	Before exercises		After exercises	
Frontfoot	Sx	Dx	Sx	Dx
Surface (cm^2)	53,50	53,00	54,25	60,50
Load (%)	23,0	18,5	22,2	23,5
Ratio HF (%)	42,6	40,1	46,3	45,1
Hindfoot	Sx	Dx	Sx	Dx
Surface (cm^2)	65,00	64,00	58,00	64,50
Load (%)	30,9	27,6	25,7	28,6
Ratio HF (%)	57,4	59,9	53,7	54,9
Total	Sx	Dx	Sx	Dx
Surface (cm^2)	118,50	117,00	112,25	125,00
Load (%)	50,3	49,7	47,3	52,7

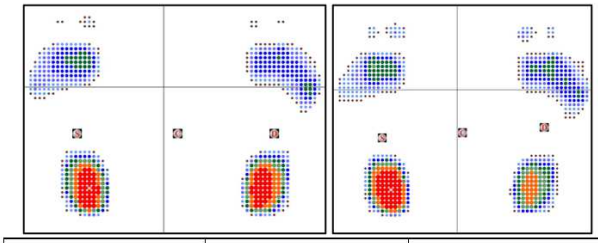
Figure 4 Static test of the 2nd subject (before therapy, after movement therapy)

The image shows (Figure 4) a visible change in the load, which was transferred from the heel to the forefoot and ensured an increase in stability with a demonstrable support, especially in the area of the 1st and 2nd toe. For the subject, it would be appropriate to further incorporate exercises to enhance the longitudinal arch and correct the adductive position of the forefoot.

3.3 Subject 3

The subject is female, has a sedentary job and suffers from right wrist pain. The subject's medical history is a carpal tunnel. In the past, she had a fracture of her left collarbone caused by a fall from a horse. The subject was diagnosed with pelvic rotation and severe spinal scoliosis during the first exercise.

The first static test did not show a change in the load on the feet but a deviation of the center of gravity, which was caused by scoliosis of the spine and rotation of the pelvis. The subject has a fairly high arch of the foot. Due to the large number of postural dysfunctions, the exercise was focused only on a certain part, which ultimately was to eliminate scoliosis. The elimination of the scoliosis should be reflected in the change of plantar pressures and in a better location of the center of gravity. After exercises in the Redcord system, the scoliosis of the spine was adjusted and the right shoulder was raised as the pain radiated to the right hand.



	Before exercises		After exercises	
Frontfoot	Sx	Dx	Sx	Dx
Surface (cm^2)	38,00	37,75	36,75	38,75
Load (%)	19,2	18,8	18,7	20,2
Ratio HF (%)	39,3	36,9	37,0	40,7
Hindfoot	Sx	Dx	Sx	Dx
Surface (cm^2)	41,25	45,25	43,50	48,00
Load (%)	29,8	32,2	31,8	29,3
Ratio HF (%)	60,7	63,1	63,0	59,3
Total	Sx	Dx	Sx	Dx
Surface (cm^2)	79,25	83,00	80,25	86,75
Load (%)	48,8	51,2	48,1	51,9

Figure 5 Static test of the 3rd subject (before therapy, after movement therapy)

In the second image (Figure 5), a slight improvement in stability is seen through the tread of the fingers. The corrected position of the center of gravity projection is also clearly visible. The subject felt pain relief after the first exercise. After 10 exercises of 40 minutes, the pain was removed. It is advisable to continue stretching exercises in the leg area as well as the entire lower limb in order to relax the contracted muscles. Subsequently, the symptoms of the high arch are expected to alleviate as well as restoration of functional biomechanical aspects of the foot.

4 Discussion

The obtained results show that Neurac therapy is suitable for correcting the distribution of plantar pressures as well as influencing the position of the center of gravity, but it would be appropriate to expand the monitored group of subjects. Furthermore, it would be appropriate to

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monitor the long-term effect of the therapy by supplementing the measurements with time intervals (for example, one month, three months and a half years after the end of the therapy). The proposed measurement procedure can also be used to check the effectiveness of other types of movement therapy. Static measurement should also be supplemented by stabilometry and dynamic test, which would indicate dynamic parameters such as step cycle symmetry on the right and left side, step width adjustment, velocity and trajectory of center of gravity oscillations, anteroposterior and lateral deviations. From these parameters, it would be possible to evaluate the effect of movement therapy on improving the stability of the subject.

5 Conclusions

The application of the Neurac method, which consists in the restoration of functional movement patterns through neuromuscular stimulation, adjusted the position of the center of gravity of the monitored subjects with a change in pelvic position. Using the Redcord system and the subsequent evaluation of static baropodometric tests, there are determined following conclusions, which are recommended to be observed for successfully correction of the center of gravity.

Before exercising with the Redcord system, it is important to warm up to prevent from possible injury or muscle fever. Proper performance of the exercises also plays an important role in preventing incorrect posture habits, especially in adolescence. In evaluating this method, the importance of compensatory exercises performed after fitness exercise was also pointed out.

In conclusion, it is worth noting that despite the low number of examined subjects, the effectiveness of the applied method is high and therefore it can be recommended as an effective method of solving the deviation of the center of gravity in functional changes of the pelvis.

Acknowledgement
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