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COMPLEX APPLICATION OF MUSCLE CONTRACTION MODES TO IMPROVE POSTURAL CONTROL IN MULTIPLE SCLEROSIS

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КОМПЛЕКСНОЕ ПРИМЕНЕНИЕ РЕЖИМОВ МЫШЕЧНЫХ СОКРАЩЕНИЙ ДЛЯ УЛУЧШЕНИЯ ПОСТУРАЛЬНОГО КОНТРОЛЯ ПРИ РАССЕЯННОМ СКЛЕРОЗЕ

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Abstract. The purpose of this study is to test the effectiveness of postural multimodal training with combined use of muscle contraction modes for multiple sclerosis. A 41-year-old woman with

very low physical activity and remmitting multiple sclerosis followed the proposed training program for 5 months, exercising mainly once a week and and several times two workouts (three weeks). The training program included exercises in an unstable standing posture, on an unstable object (bolster), strength exercises without additional weights for the lower and upper body. Postural balance testing was performed using the Berg scale and wall sit, also evaluated functional independence in moving up the stairs. The results shows of the effectiveness of the method for improving dynamic and static postural control, as well as increased functional performance in climbing and descending stairs. A combination (or hybrid) method using three modes of muscle contraction as a form of multimodal training may be recommended for individuals with multiple sclerosis in order to improve postural control.

Keywords: postural control, multiple sclerosis, muscle contractions modes, postural multimodal training, balance.

Аннотация. Целью этого исследования является проверка эффективности постуральной мультимодальной тренировки с комбинированным использованием режимов мышечных сокращений при рассеянном склерозе. Женщина в возрасте 41 года с ремиттирующим рассеянным склерозом и с низкой физической активностью выполняла предложенную тренировочную программу в течение пяти месяцев, занимаясь в основном один раз в неделю, в течение трех недель проведя по две тренировки. Тренировочная программа включала в себя упражнения в нестабильных позах, на нестабильном предмете (болстер), силовые упражнения без дополнительного отягощения для нижней и верхней части тела. Тестирование постурального баланса проводилось по шкале Берга,седу у стены, а также оценивались функциональные возможности при подъеме по лестнице и спуске с нее. Результаты показали эффективность методики как для улучшения динамического и статического постурального контроля, так и в повышении функциональной подготовленности при подъеме и спуске по лестнице. Комбинационный (или гибридный) метод с использованием трех режимов мышечных сокращений как вид мультимодальной тренировки может быть рекомендован для лиц с рассеянным склерозом в целях улучшения постурального контроля.

Ключевые слова: постуральный контроль, рассеянный склероз, режимы мышечных сокращений, постуральная модальная тренировка, баланс.

1. Introduction

Physiological mechanisms of postural control

Internal representation system (concept of body schema) consists of 2 levels (Gurfinkel et al., 1991):

- The lower level is the basic system of postural automatisms;
- The upper level is an internal model of your own body, the basis for the control of complex movements in space and the formation of a frame of reference (Gurfinkel et al., 1991).

Activity is inherent in any pose. Postural control is dynamically regulated even in a relaxed posture (Gurfinkel et al., 2006).

Postural control is a complex skill based on the dynamic effects of sensorimotor processes. The main functions of postural control are postural orientation and balance. The coordination strategy of movement, in addition to the external displacement of the posture, depends on the expectations, goals and previous experience of the person (Horak, 2006).

Undoubtedly, movement and immobility are closely related, but they differ significantly. The data obtained from various modalities of motor control (gaze control, posture, etc.) reveal a burst of activity during transitional movements, in contrast to the degree of activity when maintaining a posture (Shadmehr, 2017).

Postural tone lies at the heart the postural activity of a person sitting or standing, and the level of tonic activity has a significant effect on postural orientation (İvanenko, Gurfinkel, 2018).

In a study by Kluzik et al., postural effects were observed after being on an inclined surface with eyes closed. When shifting to a horizontal position, some participants leaned forward, apparently relying on proprioceptive information, while others seem to rely more on sensory information related to strength and load (Kuzik et al., 2005).

Postural control in multiple sclerosis

A number of studies show that postural imbalance is common in individuals with multiple sclerosis (MS). People with MS have the following disorders of postural control (Cameron, Lord, 2010):

Low ability to hold posture.

They are characterized by the swang of the body when trying to maintain position (Soyuer et al., 2006; Cattaneo, Jonsdottir, 2009). Postural oscillation with closed eyes increases much more than in healthy people (Daley, Swank, 1983; Ramdharry, 2006). Naturally, people with MS experience even greater difficulties in less stable postures: standing on one leg or in tandem positioning of the legs (one after the other) (Frzovic, 2000).

Poor response to postural displacement and perturbation, poor trunk control.

In a study by Diener et al. (1984), late response was considered in response to perturbation when raising toes while standing. There is also evidence of a delay in the postural response to forward and backward displacements while standing (Jackson et al. 1995) and forward peturbation (Williams et al. 1997).

People with MS have poor trunk control when sitting on an unstable surface (Lanzetta et al. 2004).

The existing walking restrictions in individuals with MS (shorter stride length and lower pace) (Benedetti et al., 1999; Grenshaw et al. 2006) can be regarded as a secondary disorders based on poor postural control.

2. Materials and Methods

In the described case from practice, a 41-year-old woman with remmitting sclerosis and low physical activity took part. Postural training took place from June to October 2021. It was suggested to do three workouts per week. But, basically, it turned out to carry out one workout per week (based on M.'s wishes and capabilities that have nothing to do with physical training), less often two workouts (3 weeks). It should be noted that M. almost completely missed classes in August (only one training session was held). In general, the number of training was 22.

Training methodology

1.Complex use of three types of muscle contractions - isometric, eccentric, concentric. What is meant by this?

This is a slow tempo (3 sec.) In the lowering phase (eccentric), fixing the position (isometric) for 1-2 sec. at the end point (for example, in the military press, this is the top point, and in squats, the bottom point), and 1 sec. in the ascent phase (concentric).

2. Maintaining a neutral spine - As defined by Panjabi (1992), the neutral zone is the area where the spine receives the least load. The neutral position is understood as the passage of a clear line (in practice, it is convenient to use a gymnastic stick at the initial stages and for a visual explanation) with the touch of the stick to the body at three points: the occipital region , thoracic kyphosis, and the sacrum. Moving away from these points means moving away from neutral position.

3. Proprioceptive amplification - doing exercises with your eyes closed. Unlike the two abovementioned components, it was used on an ongoing basis only at the initial stage (8 weeks).

The structure of the training program

Each session consisted of three blocks.

1. Unstable posture in sitting and lying position (movements were performed on a bolster). Examples of commonly used exercises:

Trunk flexion, lifting straight arms with greater support on one leg (support of the front leg on the heel), synchronous abduction of the arms and knees to the sides in lie, etc.

2. Strength for the lower body – Wall squats, trunk flexion with slightly bent knees

"scissors" with a small amplitude in the comfort zone (asymmetric load on the legs), etc.

3. Unstable standing position – Military press with open palms (not heavy books used), adduction hands over head, side rotation of the trunk (outstretched arms at chest level) and etc. (all movements were performed in a tandem stance, in the initial stages, the distance between the legs was greater).

3. Results

Despite the fact that training was carried out rarely and there was a period of skipping class-

es, this experience showed the effectiveness of the applied method for multiple sclerosis. In terms of dynamic postural control (standing on one leg, one after the other, etc.), the progress was very clear. But, and on static postural control (fixing the position against the wall), obvious progress was made. A convincing improvement was also observed in important motor function such as climbing and descending stairs.

Change in postural balance and functional capability

Tests	Before	After
To climb up the stairs	25% (with max support)	75% (with min support)
Feet together	0/4	2/4
Standing on one leg with eyes opened	1/4	On left foot 4/4
On right foot 3/4		
Standing on one leg with eyes closed	0/4	1/4
Tandem stance		
(one foot in front)	0	4
Turn around and look over your shoulder	2/4	4
Pick up object from the floor	3/4	4
Total points of Berg scale	30/56	46/56
Wall sit*	0/4	2/4

* – the author's version of the adaptation of standards for non-athletes (the stabilization capabilities of the lower body are assessed):

0 – unable to fix the position at an angle of 90 degrees;

1 – the position is fixed, but the stabilization is weak, <10 seconds;

2 – 10–20 seconds;

3 – 20–30 seconds;

4 – > 30 seconds (recommended for starting resistance training).

4. Discussion

In a study by Sandroff et al. (2017) in individuals with multiple sclerosis, a long-term comparison revealed the advantage of multimodal training over the control group in increasing endurance and cognitive speed. Speaking specifically about training for postural balance. According to another study (Ali et al. 2021), where the participants were divided into three groups: control (balance exercises), research I (additionally performed core stability exercises while maintaining the neutral position of the spine), research II (tasks-oriented training was used as a supplement), for people with multiple sclerosis, it is more effective to supplement balance training with core stability exercises or task-oriented training. Given the significant predominance of task oriented training in Berg's results, it is these exercises that are effectively included in the training program for people with multiple sclerosis.

Under the complex for the stability of the core is meant the performance of exercises in various positions - lying on the back, lying on the side, sitting and standing (Soysal et al., 2016). Unfortunately, the presented material does not provide a detailed description of the exercises performed, which would obviously help to better consider the proposed complex.

Task oriented training (Eftekharsadat et al., 2015) consisted of getting up from a chair of various heights with walking a short distance, pulling forward and sideways to objects in unstable positions (tandem and parallel stance), lowering down with reaching for the object, etc.

This case study, in which the main objective was to increase functionality and achieve tangible progress in dynamic and static postural balance, firstly, consistent with previous studies, shows the importance of multimodal training for individuals with multiple sclerosis, and secondly, opens up new op-

portunities, offering postural training with hybrid approach from muscle contraction modes.

5. Conclusions

The described long-term positive results obtained using a postural training method with combining three types of muscle contractions (hybrid method), which can be considered a type of multimodal training, can be useful as physiotherapy for people with multiple sclerosis.

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