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METHODS OF CORRECTION OF ORTHOPEDIC FOOT DISORDERS IN PATIENTS WITH MULTIPLE SCLEROSIS

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Annotation. Patients with multiple sclerosis (MS) often have orthopedic disorders of the feet (changes in the tone of the muscles of the lower leg, valgus or sail deformity). Such disorders occur due to spasticity of the muscles of the posterior surface of the lower leg and weakness of the anterior. This article discusses the effectiveness of a set of physical exercises and orthopedic braces used after botulinum therapy. According to the results of the work, a positive effect of the proposed technique was revealed on leg supportability (improvement in the Romberg test on two legs by 92.3% $t=8$, $p\leq 0.01$; improvement in the Romberg test on one leg by 144% $t=9.4$, $p\leq 0.01$) and lower leg muscle strength (improvement in the test task "toe lifts in 30 seconds" by 133.3% $t=11.5$, $p\leq 0.01$; improvement in the test task "dorsiflexion in the ankle joint while sitting in 30 seconds" by 400% $t=23.4$, $p\leq 0.01$).

Keywords: orthopedic foot disorders, feet valgus, multiple sclerosis, neuro-orthopedics.

Introduction One of the current problems of patients with multiple sclerosis is spasticity of the lower leg muscles. This problem affects the patients' ability to walk [1]. In this case, patients can often perform such tasks as "toe lift" and plantar flexion in the ankle joint, but are dorsiflexion in the ankle joint is practically impossible. Such imbalance is associated with increased muscle tone of the posterior surface of the tibia and weakened extensor muscles of the foot and toes. In addition, patients also develop feet valgus or varus due to improper distribution of the load on the feet [2]. As methods of correction, a number of modern authors mention botulinum therapy, wearing orthopedic braces, braces with myostimulation (for example, walkaide), therapeutic gymnastics, orthopedic shoes, taping, hydrotherapy et al. At the same time, many authors note the importance of using physical exercises after botulinum therapy of the lower leg muscles [3]. It is due to the fact that botulinum injection lowers the muscles' spasticity, which allows performing exercises that were earlier inaccessible.

We have assumed that application of a set of exercises with orthopedic correction with braces after botulinum therapy would have a positive effect on strength of the foot muscles and support ability of the legs.

The purpose of our study was to identify effectiveness of a developed set of exercises accompanied with application of orthopedic braces after botulinum therapy on support ability of the legs of strength of the lower leg muscles.

Methods and organization. The study included 10 patients aged 30-40 with remitting and secondary progressive MS who had orthopedic foot disorders and botulinum therapy within 2-7 days prior to the study. The inclusion criteria: spasticity of the lower leg muscles before botulinum therapy, valgus deformity of the feet, preserved walking function with 1 or 2 supports (more than 300 meters), ability to maintain balance without a support, agreement to perform a set of exercises daily for 6 months. The study took place in the Moscow Society of Multiple Sclerosis for 6 months, from September 2022 to February 2023.

As a method of correction, the patients were prescribed a set of exercises for daily performance. The complex included exercises for stretching and relaxing the muscles of the posterior surface of the lower leg; strengthening the muscles responsible for the extension of the foot and toes; exercises to strengthen the muscles of the thigh and buttocks; passive development exercises for the ankle joint and passive movements of the toes. The set took

15-20 minutes, each 3 weeks the exercises were revised and made more difficult. For the first 3 months, the initial positions were lying on a floor and sitting in a chair, then exercises while standing and walking were added. As an additional method, special orthopedic braces used for neurological patients to correct the foot position were worn daily during walking and standing exercises.

At the beginning and at the end of the study we applied methods for functional assessment of the lower leg strength and the feet support ability:

1) toe lifts in 30 seconds (maximum number of tries) – one could hold on to the extra support while doing the test;

2) dorsiflexion in the ankle joint while sitting in 30 seconds (number of tries) – the test was performed sitting on a chair with the leg bent 90 degrees at the knee and hip joints, and the patients were asked to perform dorsiflexion in the ankle joint with as much amplitude as possible;

3) keeping balance in the Romberg test on two legs with eyes open (maximum time in seconds) – patients took an initial position with legs together and arms outstretched forward, and the time to loss of balance was assessed;

4) keeping balance in the Romberg test on one leg with eyes open (maximum time in seconds) – patients took an initial position on one leg, with the other leg bent and pressed to the shin by the medial part of the foot, the knee joint of the bent leg pointing forward, arms outstretched forward, and the time to loss of balance was assessed.

To evaluate statistical significance of the study we used math-and-stats methods of (calculation of arithmetic mean, standard deviation, difference and Student's t-test if $p \leq 0.01$), normality of distribution was identified with the Kolmogorov-Smirnov test. Calculations were performed with the Stata software.

Results and discussion. At the final stage the obtained results were processed with the aforementioned methods and tabulated.

Table

Test results obtained as part of the study

Tests	n=10					
	Before	After	Difference		T_{emp} (if $t_{\text{cr}}=3.1$)	$P \leq$
			absol	%		
Toe lifts in 30 s, number of tries	6±2.1	14±3.5	8	133.3	11.5	0.01
Dorsiflexion in the ankle joint while sitting in 30 s, number of tries	1.2±1.1	6±2.6	4,8	400	23.4	0.01
Keeping balance in the Romberg test on two legs, s	18.2±6.5	35±8	16,8	92.3	8	0.01
Keeping balance in the Romberg test on one leg, s	5±5.3	12.2±4.3	7.2	44	9.4	0.01

The results obtained show a trend for improvement of all studied indicators, which reflect effectiveness of the developed program and positive effect of selected exercises. Indices of the lower leg strength increased by 133.3%, $t=11.5$, $p \leq 0.01$ (“toe lifts in 30 s”) and by 400%, $t=23.4$, $p \leq 0.01$ (“dorsiflexion in the ankle joint while sitting in 30 s”). The Romberg test indices also demonstrated improvement: by 92.3%, $t=8$, $p \leq 0.01$ for keeping balance on two legs and

by 144%, $t=9.4$, $p \leq 0.01$ for keeping balance on one leg.

Conclusion. The method for correction of orthopedic foot disorders in patients with multiple sclerosis, based on the use of special complexes of exercises and wearing orthopedic braces after botulinum therapy of the lower leg muscles, has proven effective. This technique can be recommended for neurological patients with orthopedic foot disorders.

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