EFFECTS OF POSTURAL TRAINING ON WALKING SPEED IN PATIENTS WITH CHRONIC STROKE

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Abstract: Walking speed measurement is an easy and accessible tool that provides information about the functional capacity of patients. It is used as a "sixth vital sign", because is a potential variable risk factor after monitoring blood pressure, pulse, respiratory rate, temperature, and pain (Fritz, Lusardi, 2009). It has been found that measuring gait speed in an outpatient setting can allow the detection of healthy adults at risk of adverse events (Montero-Odasso, Schapira, Soriano et al., 2005). Gait speed is a powerful indicator of function and prognosis in stroke patients. Increasing it leads to a transition to a higher class of ambulation, which leads to better function and quality of life (Schmid, Duncan, Studenski et al., 2007). Studies present the factors influencing gait speed in stroke patients. Velocity is mainly influenced by the weakness of the affected hip flexors and knee extensors, while gait asymmetry is mainly influenced by the degree of spasticity of the affected plantar flexors (Hsu, Tang, Jan, 2003). Another important factor in improving gait speed is energy expenditure, which decreases with faster and more symmetrical gait in patients with chronic stroke (Awad, Palmer, Pohlig et al, 2015). Stroke patients have atypical patterns of step initiation and premonitory posture corrections (Delafontaine, A., Villaeron, T., 2019). The ability to maintain control of the body is essential for movement, which can be significantly impaired and to reduce movement speed and balance (Yang, Park, Kim, 2020). Other studies report that gait speed and symmetry are improved through exercises for the torso, which may be due to the increase in weight that is transferred to the affected leg during walking due to improved symmetrical pelvic movement. Carcass exercises performed on an unstable surface also significantly improve body muscle activation, postural control, and gait speed in stroke patients (Jung, Cho, 2016). Robotic body control training combined with kinesitherapy also shows positive effects on balance, ability and gait speed (Lim, 2020). The aim of the present study was to investigate the effect of postural training on gait speed in patients with chronic stroke. A specialized kinesitherapy technique was applied to a routine approach to motor therapy, covering 46 patients with chronic stroke, and the experimental group included 34 patients - 16 men and 18 women, with a disease duration of 27.15 ± 17.61 months, and the control group, including 12 patients - 5 men and 7 women, with a disease duration of 19.5 ± 14.68 months. Evaluation of early, intermediate and late effects of the performed kinesitherapy was performed, respectively on the 10th day, 1st month and 3rd month from the beginning of the program, using a 10 meter test, which shows excellent reliability in retesting (Cheng, Nelson, 2020). The study showed a significant improvement in gait speed in patients in the experimental group. In conclusion, the application of motor therapy aimed at postural control in patients with chronic stroke shows lasting improvements in movement speed. It is recommended that the motor program be modified according to the patient's needs. The individual orientation and the performance of kinesitherapy in outpatient conditions lead to an increase in the patient's motivation and the achievement of the set goals.
Keywords: kinesitherapy, postural control, stroke, chronic period

1. INTRODUCTION

The functional mobility of patients with chronic stroke can be measured by the 10-meter gait test. This test takes into account the normal and maximum gait speed in meters per second. In order to perform this test, the patient must be able to move without assistance and can use aids. The assessment of gait speed provides information about the patient's quality of life related to his potential independence and socialization. An important role in the speed of movement is played by the postural control, through which the energy consumption and the stability of the body and lower limbs during walking can be improved.

2. MATERIALS AND METHODS

The aim of the study was to evaluate the effect of the application of a specialized kinesitherapy technique for postural training on walking speed in patients with chronic stroke compared to a routine approach to motor therapy. For this purpose, a specialized methodology for kinesitherapy has been developed based on modern principles of neurorehabilitation, which is adapted for use in the home environment. The early (10th day), intermediate (1st month) and late (3rd month) effects of the application of specialized kinesitherapy with a duration of three months, compared with the routinely applied (10 day duration), on the rate of walking, assessed by the 10-meter test. The

statistical methods of the Paired Samples Test for dependent samples and the Independent Sample Test for independent samples were used.

The study included patients who had a stroke more than 6 months ago, who had a grade of at least 2 in the category of functional gait (need continuous or periodic support from 1 person to help balance and coordination), no change in medication treatment during the kinesitherapy program and do not have severe somatic diseases. Patients also had no cognitive or memory impairment, severe progressive neurological disease, and had given written informed consent to participate in the study. Patients with acute stroke and previous cerebral haemorrhages, bilateral or severe paresis, and patients who refused to participate in the study were not included.

The two kinesitherapy techniques used are different in duration of treatment, structure and kinesitherapeutic agents involved. The study included 46 patients with chronic stroke, the experimental group (EG) included 34 patients - 16 men and 18 women, with a disease duration of 27.15 ± 17.61 months, and the control group (CG), including 12 patients - 5 men and 7 women, with a disease duration of 19.5 ± 14.68 months. Evaluation of early, intermediate and late effects of the conducted kinesitherapy was performed, respectively on the 10th day, 1st month and 3rd month from the beginning of the program.

3. RESULTS

A comparative analysis was made between the application of a specialized kinesitherapy technique in an experimental group and conventional kinesitherapy in a control group. The results of the monitored indicators in both groups of patients are presented in Table1. The differences between the obtained and baseline values, as well as the significance of the changes in the subjects between the experimental and control groups are presented in Figure 1.

The initial data of the two groups show the presence of impaired physical performance, without significant differences between the two groups. After treatment, there was a significant improvement in physical fitness and patient performance, according to the 10-meter gait test presented in Table 1. Compared to baseline, there was an increase in the number of points measured in both groups. The quarterly application of a specialized kinesitherapy technique leads to significant and lasting changes in the normal and maximum gait speed in patients with chronic stroke.

Table 1. Evaluation of the normal and maximum gait speed in the monitored patients during the treatment

Parameters	Group	Begining ЕГ (n=34) КГ (n=12) $X \pm S_D$	Day 10 ЕГ (n=34) КГ (n=12) $X \pm S_D$	1 month ЕГ (n=34) КГ (n=12) $X \pm S_D$	3 month ЕГ (n=34) КГ (n=12) $X \pm S_D$
Normal speed	EG CG P	17.9±2.2 16.8±2.0 0.122	17.2±2.0*** 16.2±2.1** 0.183	15.8±2.0*** 15.5±2.1*** 0.632	14.2±2.3*** 14.5±2.1*** 0.615
Maximum speed	EG CG P	15.8±2.6 14.7±2.2 0.161	15.1±2.4*** 14.2±2.2** 0.262	13.7±2.0*** 13.0±1.9*** 0.365	11.4±1.9*** 11.6±1.9*** 0.764

*X ± SD - mean and standard deviation, *** p <0.001, ** p <0.01 - significant change compared to baseline values during treatment, assessed by Paired Samples Test for dependent samples; P <0.001, P <0.01 - significance of the change between the two study groups, assessed by the Independent Samples Test for independent samples.*

The difference between the obtained and baseline values in the examined patients from the two groups is presented in Figure 1 for normal gait speed and Figure 2 for maximum gait speed.

After the applied kinesitherapy, a significant increase in the speed of movement was observed in both groups of patients. Compared to baseline, there was a significant increase in normal and maximal gait speed throughout the treatment period.

In the followed patients of the experimental group, there was an increase in the normal gait rate from 17.9 to 17.2 on the 10th day, 15.8 on the 1st month and 14.2 seconds on the 3rd month. The level of significance of the changes throughout the treatment period was p <0.001.

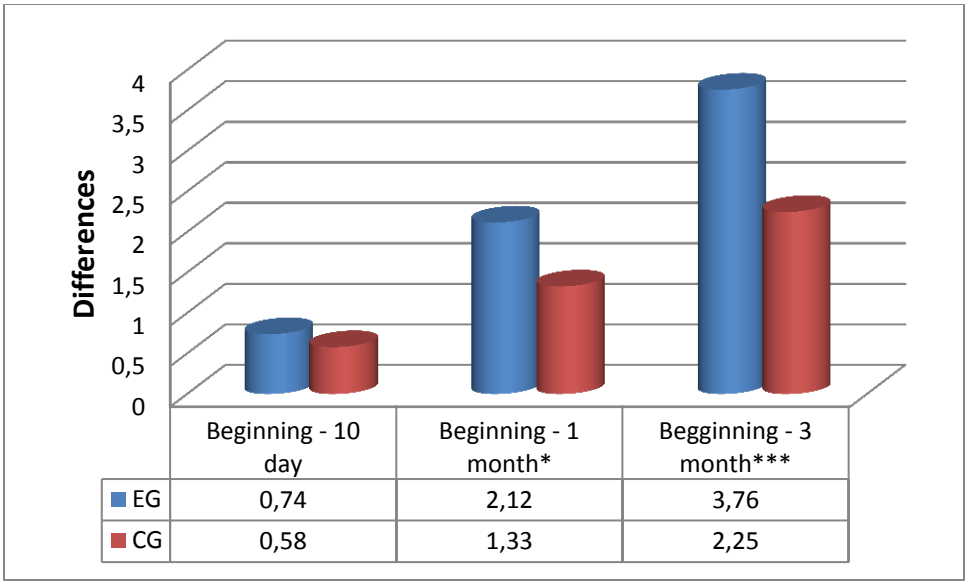

Figure 1. Changes in normal gait speed, according to the 10-meter gait test, presented as the difference between the results obtained and the baseline values of the two study groups; *** P <0.001, * P <0.05 - significance of the change between the two study groups, assessed by the Independent Samples Test for independent samples.

The data for the normal gait speed in the patients in the control group are similar. The initial normal rate was 16.8 and reached 16.2 seconds on day 10, with the significance level of this change being p <0.01. The speed of movement increased to 15.5 seconds in the 1st month and 14.5 seconds in the 3rd month with significance levels p <0.001.

Significant differences between the experimental and control groups were reported at 1st and 3rd months from the beginning of the follow-up period, with a significance level of p <0.5 and p <0.001, respectively.

Significant changes were also reported in the maximum movement speed of the patients in the experimental group, as the initial value was 15.8 seconds and increased to 15.1 seconds on the 10th day. Gait speed continues to increase to 13.7 in the 1st month and 11.4 in the 3rd month. The reported changes during the treatment period had a significance level of p <0.001.

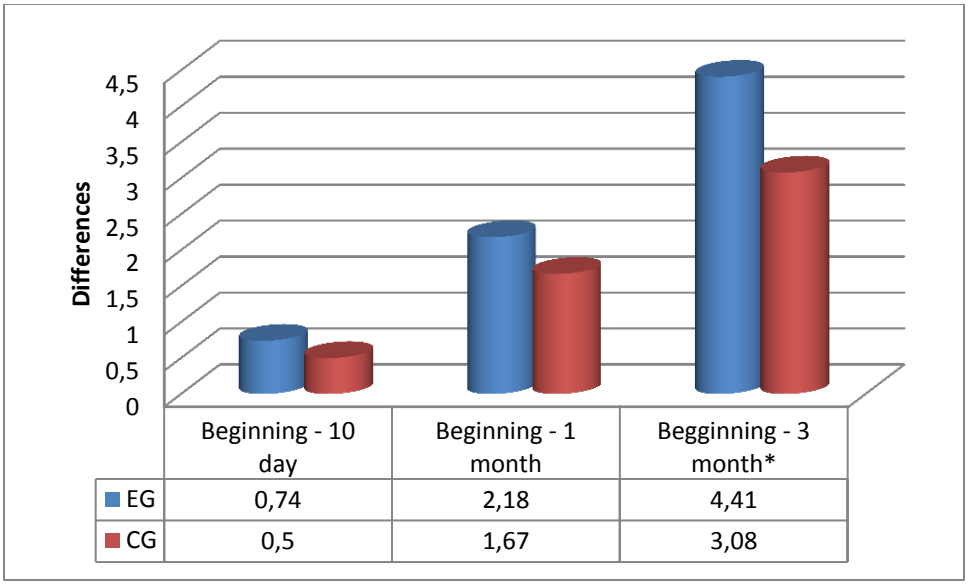

Figure 2. Changes in the maximum gait speed, according to the 10-meter gait test, presented as the difference between the results obtained and the baseline values of the two study groups; * P <0.05 - significance of the change between the two study groups, assessed by the Independent Samples Test for independent samples.

Significant improvements were also reported at the maximum movement speed of the patients in the control group. At the beginning of the follow-up period, the rate was 14.7 seconds and reached 14.2 on the 10th day with a significance level of $p < 0.01$. The maximal rate increased to 13.0 at month 1st and 11.6 at month 3rd, with both changes having a significance level of $p < 0.001$.

A significant difference in the maximum gait speed between the experimental and control groups of patients was observed at 3rd month, significance level $p < 0.05$.

The presented results clearly emphasize the different trend of changes in the experimental and control patients and the significant change between the two groups in the course of the quarterly study in patients with chronic stroke. The applied specialized kinesitherapy methodology significantly improved the speed of normal and maximum gait, as the observed positive effects accumulated throughout the follow-up period. Unlike patients in the control group, the specialized kinesitherapy methodology showed progressive improvement throughout the follow-up period.

4. DISCUSSIONS

The scientific research has a contribution of scientific-theoretical and scientific-applied nature. Confirms the thesis of a possible improvement in the speed of movement in patients with chronic stroke (dating more than 6 months). There are lasting improvements in impaired motor function through long-term, targeted and intensive kinesitherapy. The effects of routine kinesitherapy are transient due to their short-term use for 10 days.

For the purpose of the study, a practical guide for the application of specialized kinesitherapy methodic at home was developed. This practical contribution is intended for patients with chronic stroke.

5. CONCLUSIONS

The specialized kinesitherapy methodology developed by us, continued as a three-month program for exercises at home, has positive early, intermediate and late effects on the normal and maximum gait speed in patients with chronic stroke. In contrast, a 10-day routine kinesitherapy showed a brief positive effect. The differences between the effects of the two compared kinesitherapy methods are related to the different duration of the applied motor therapy, the structure of its application and expediency.

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