



MIRROR THERAPY IN PHYSIOTHERAPEUTIC PRACTICE FOR RECOVERY OF THE MOTOR FUNCTION OF THE UPPER LIMB IN PATIENTS WITH ISCHEMIC STROKE

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ABSTRACT:

Cerebrovascular diseases occupy a major place among socially significant diseases due to high morbidity, mortality and severe disability. Bulgaria is one of the first places in the world in these indicators. Timely and properly applied, physiotherapy has a positive effect on their independence and self-care. Modern physiotherapy is based on the theory of neuroplasticity - the ability of the brain to change adaptively with significant changes in the body and the environment. Mirror therapy is a contemporary approach to restoring the function of the upper limb after a stroke. It is based on the principle of stimulating movement in the affected limb through visual signals coming from the other side of the body. This aroused the interest to develop and implement a program and methodology of its application, including mirror therapy. The aim of the study was: To develop and implement a physiotherapy program and methodology of its application, including mirror therapy, to improve motor function of the upper limb in the recovery of patients with ischemic brain disease and to study the effect of its application.

The present study was conducted in the Department of Physical and Rehabilitation Medicine of the University Hospital "Medica-Russe" in the period from January 2019 to June 2020. Of the patients diagnosed with ischemic stroke, were formed two groups - control and experimental. Ten patients were included in each group. The presented own results make it possible to analyze the effect of the applied complex physiotherapy program and mirror therapy in the late recovery period.

Keywords: physical therapy, mirror therapy, stroke, stroke rehabilitation, physiotherapy

INTRODUCTION

Worldwide, according to the WHO, 15 million people suffer from ischemic stroke each year, of which 4 381 000 die, and about 5 million remain permanently disabled, ranking the disease second in mortality after coronary heart disease (6 260 000 people). Bulgaria is one of the leading countries in terms of morbidity, morbidity and mortality from strokes. According to official data, 680 per

100,000 people are hospitalized annually as a result of cerebrovascular diseases, of which 270 per 100,000 die (270.1 / 100,000 - men 265.1 / 100,000 - women), as in the age group 45 -54 years mortality is 105.5 / 100,000 for men and 44.1 / 100,000 for women. In the countries of the European Union, this figure is 62 people, for the USA - 34 people. Based on these grim statistics, we can conclude that in Bulgaria, 9 times more people die as a result of ischemic stroke than in the United States and 4.5 times more than in the European Union. [1].

Cerebrovascular disease (MSD) is a global medical, social and economic problem. Every year, about 15 million people worldwide suffer a stroke, and more than 4 million of them do not survive. About a quarter are under 65. More than a third of the survivors remain with some degree of disability. People who have experienced a stroke are at increased risk of having one. About 80% - 85% of strokes are ischemic (cerebral infarctions), and the rest are hemorrhagic [2]. According to data from the National Center for Public Health and Analysis, in 2018, 158 Bulgarians suffered a stroke every day, and the number of patients with ischemic stroke amounted to 49 717 people. The total number of hospitalized patients for the past year and those not treated in the hospital were 57 802. Of these, 55 366 were admitted to a health facility and 5 505 people died. Stroke was suffered by 27 114 women, over the age of 55 men of the same age - 23 752. A large proportion of stroke survivors suffer from reduced limb function six months or more after the stroke. Therefore, they require long-term rehabilitation, which is very specific and strictly individual. In recent years, the classic notion that the central nervous system does not regenerate after an injury has evolved. Numerous studies show that, although limited, the ability of the human brain to reorganize continues throughout life, which is associated with cerebral plasticity at two functional levels: sensorimotor cortex (cortical plasticity) and neural network (neuronal plasticity). It is achieved by activating functionally inactive nerve cells, synapses and pathways, changing their number, shape and size, as well as the formation of new neurons [3]. The damaged brain uses stored nerve pathways and systems to compensate for the neurological deficit, in which the involvement of the unaffected cer-

eral hemisphere is greater. [4] In the recovery process, there is a faster improvement in the mobility of the lower limb and related activities such as walking moving from sitting to standing, which makes the patient more independent [5]. The upper limb and the arm have a larger number of conditioned reflex connections connected with other nerve structures. Therefore, the process of recovery and compensation of the functionality of the upper limb is difficult and long work, requiring high professionalism and the introduction of new methods of recovery [6]. A modern consensus on upper limb physiotherapy in stroke patients has been developed depending on the severity of the paresis determined by the Chedoke-McMaster test. In patients with severe impairment, maintenance of a comfortable position and compensatory techniques are applied, which allow performing important activities for the unaffected upper limb. In patients with moderate and mild disabilities, repetitive, intense new tasks are included, which provoke the patient to acquire the necessary motor skills to perform functional activities, as well as participation in motor training [7]. Mirror therapy is a modern approach to restoring the function of the upper limb after a stroke. It is based on the principle of stimulating movement in the affected limb through visual signals coming from the other side of the body [8].

Without seeing the affected limb, the patient tries to mirror it on the movements performed with the unaffected limb. It creates a visual illusion of normal movement of the affected limb by activating mirror neurons and sensorimotor training of the affected cortical centers [9]. Scientific articles were found in the literature, randomized controlled trials on the benefits of mirror therapy, as well as its comparison with other rehabilitation approaches. Eleven studies involving a total of 347 patients were included in the meta-analysis. Although the included studies are highly heterogeneous, meta-analysis provides some evidence that mirror therapy can significantly improve motor function of the upper limb in stroke patients. Additional well-designed studies are needed to demonstrate the clinical efficacy of mirror therapy. This aroused interest, and hence The aim of the study: To develop and implement a physiotherapy program and methodology of its application, including mirror therapy to improve motor function of the upper limb in the recovery of patients with ischemic brain disease and to study the effect of its application. The object of study is: the content of the developed physiotherapy program and the algorithm of its application in patients with ischemic stroke. The subject of study is: the effectiveness of the developed and tested in practice physiotherapy program for recovery in patients with ischemic brain disease.

ORGANIZATION AND METHODOLOGY OF THE RESEARCH

The present study was conducted in the Department of Physical and Rehabilitation Medicine of the University Hospital "Medica-Ruse" in the period from January 2019 to June 2020. Of the patients diagnosed with ischemic stroke, were formed two groups - control and ex-

perimental. Ten patients were included in each group. The control group consisted of 4 women and 6 men, their average age was 61,1 years. The experimental group consisted of 6 women and 4 men with a mean age of 67,8 years.

Physiotherapy procedures were performed under the same conditions for all patients.

- *Criteria for inclusion of patients in the study:*

- presence of ischemic stroke;
- presence of right-sided or left-sided central hemiparesis;
- after the acute period of stroke - late recovery period;

- *Criteria for exclusion of patients from the study:*

- occurrence of severe complications of the cardiovascular, respiratory system, etc.;
- unspecified stroke conditions;
- patients with concomitant diseases in whom physiotherapy is not indicated;
- patients with cardiopulmonary abnormalities who are unable to sit during treatment are not eligible for this type of treatment.

- *Criteria for inclusion of patients in the application of mirror therapy:*

- the patients in the experimental group have preserved visual abilities;
- patients must have sufficient cognitive and verbal abilities (attention, working memory and concentration) to focus for at least ten minutes on the reflection of the mirror and follow the instructions given by the therapist;
- there must be a possible and painless range of motion in the unaffected limb;
- jewelry and other visual signs should be removed or hidden to make it easier for the patient to perceive the reflection as an affected limb when looking in the mirror;
- patients should be adequately instructed for the purposes of mirror therapy;
- patients should have the desire and the positive thought to get involved in this type of treatment and be asked to imagine and feel that the mirror image is their affected limb;
- to free the environment from other stimuli that attract patients' attention.

The methodology of physiotherapy, which was applied in the experimental group, aimed to improve and restore the motor functions of the upper limb, reduce pain, restore fine motor skills, proper and ergonomic performance of everyday activities. In the patients of the control and experimental group, we implemented a program that includes tools tailored to the individual condition and deficit of each patient: active-assisted, active, breathing exercises, proprioceptive neuromuscular facilitation, exercises on devices, mechanotherapy, sensory exercises, exercises with a Swiss ball, mobilizations of the peripheral joints of the upper limb. In the experimental group, before starting the set of exercises, mirror therapy was applied with a duration starting from 10 minutes and with a

gradual increase to 30 minutes. In the control group, only the set of exercises was applied. The methods for functional examination and evaluation that were used: anamnesis data, somatic and neurological status, diagnostic imaging data - computed tomography, MRI, electromyography; Barthel Index; Brunnstrom test; Ashworth test; Mischels test; Fugl-Meyer test; Abilhand test; Visual Analog Scale (VAS).

The procedure began with the placement of the patient, the correct positioning of the affected hand in relation to the mirror at a certain angle in front of the body for the optimal image of the healthy hand, which the patient must follow. The position of the unaffected limb is similar to that of the affected limb. The duration of the first and second sessions was 10-15 minutes (individually for each patient). After a sequence diagram was created for performing the exercises and learning them, the mirror therapy lasted 25-30 minutes. Exercises at the beginning of the session were basic, active for shoulder, elbow, wrist joint and for all fingers (flexion and extension of the fingers, wrist and elbow, removal and reduction of the wrist and thumb, opposition of the thumb, supination and pronation of the forearm). All movements were performed very slowly, as this facilitates the intensity of the mirror illusion. The repetitions of each movement were 10 to 15 times.

After the main exercises, the program included functional activities with various subjects. In the process of therapy, the exercises were performed as a movement only with a healthy hand to bilateral performance. In some of the patients, reluctance and the necessary reduction of the arm were reported. They were verbally stimulated by the physiotherapist, which contributed to the more accurate performance of the exercises - independently and correctly, as well as the confidence that the process will continue in the same way at home. Some of the participants in the experimental group reported slight discomfort when staring in the mirror, which passed after the second session. Others reported mild fatigue at first due to the concentration and attention required for effect.

RESULTS:

Based on age, diagnosis and degree of disability, the groups are approximately homogeneous, which gives reason to compare the results. The presented own results make it possible to analyze the effect of applied physiotherapy. For this purpose, a follow-up of various assessed indicators was performed at the beginning and end of the first month of treatment. The results obtained from the applied tests of the control and experimental group were processed using the methods of medical statistics. The following parameters were calculated: X- arithmetic mean; SD- standard deviation and on this basis Student's t-test; Tp - growth rate. In order to assess the degree of ability to perform daily, the Bartel index was applied to patients in both groups.

At the beginning of treatment after the test, the results showed that patients in both groups had an equally reduced degree of ability to perform activities of daily liv-

ing. In both the control and experimental groups, the points collected after the test were 75, with slight difficulties in bathing activities; personal toilet; dressing/undressing, need a little help. At retesting after the end of the fourth week from the start of treatment, there was an improvement in self-care in patients from both groups, and in the experimental group, it was significantly greater. In the control group, the points increased to 95 a t-test: -17,55. The growth rate in this group was 23,53. In the experimental group, there was a greater improvement in the performance of daily activities. In this group, the points increased to 99 a t-test - 33,06, and compared to the control group, there was a greater improvement in activities related to bathing, personal dressing, dressing/undressing and the lack of need for help. The growth rate was significantly higher 111,93.

From the Brunnstrom test, which was performed on patients from both groups, the following results were derived for the degree of functional capabilities and the stage of functional recovery: When examining the degree of functional ability at the beginning of treatment in both control and experimental groups, an average value was determined: 3,1 performed close to the normal range of motion, but with great difficulty. After the applied physiotherapy and repeated test at the end of the first month, in the control group, the degree increased to 4,9, t-test - 8,26, the growth rate was 32,43. The movement is close to the norm but lags behind in terms of coordination. In the experimental group, after the performed physiotherapeutic procedure, grades 4,9 and t-criterion were observed -12,40 or performed the movement almost normally, like a healthy limb. The growth rate is 45. When studying the stage of functional recovery of the control and experimental group at the beginning of treatment, the arithmetic mean is 4,1 in which the spasticity decreases, the movements are enriched in different planes, performed uncoordinated and with great difficulty. After the physiotherapy procedures, at the end of the first month in the control group, a stage was determined: 5,3 in which the spasticity significantly decreased, the movements increased in volume, became more diverse and coordinated. In the experimental group at the end of the applied physiotherapy after four weeks, a greater improvement in movements and coordination was found compared to the patients in the control group, and a stage was determined: 5,9. In this group, the t-test is -12,40, the growth rate is higher at 36.

The results of the Ashworth test show that at the beginning of the treatment in both groups, there is a slight increase in tone or minimal resistance at the end of the movement. For the control and experimental groups, the data are 1,1 points for spasticity, the same which gives reason to compare them. One month after the treatment in the control group, there was a decrease in muscle tone of the arm to 0,6 points, t-test: 3,44, the growth rate is -58,82. The final results for assessment of muscle tone in patients from the experimental group are as follows: 0,1 points, the t-test is 6,89, the growth rate in the indicators is -166,67. The growth rate is negative due to a decrease in values at the end of treatment.

The Mischels test was applied to assess motor function of the upper limb in the patients of both groups. At the beginning of the treatment, the test performed gives a score of 17,4 points for the control group and 17,2 points for the experimental group. After four weeks of physiotherapy in control patients and final testing, the points increased to 23,7, t-test: -7,13. The growth rate in this group is 30,66. The experimental group showed greater improvement and higher baseline results - 31,8 points and t-test: -27,89, and compared to the control group, there is almost normal movement in the performance of the test. The growth rate is significantly higher - 59,59. The reported better results of the patients from the experimental group are a result of the effectiveness of the applied mirror therapy. The observed possibilities for performing active movements in the group with applied mirror therapy show significant improvements in the motor function of the arm.

To assess the abilities of the upper limb, according to the difficulty perceived by the patient, when performing tasks related to the daily activities of both hands, the Abilhand test was used. After conducting the initial study, the results showed difficulty in performing the specific activities in both groups. After the daily physiotherapy, a significant improvement and almost no difficulty in performing the activities was found, especially in the patients in the experimental group. The final results for the control group were 36,9 points, t-test: - 22,06, and growth rate - 48,90. In the experimental group, the points were 45,5, t-test: - 57,40, which indicates an almost normal performance of the activities without difficulty.

The Fugl-Meyer test for the upper limbs was applied for monitor the result of the performed physiotherapy and the effect of the applied mirror therapy for the restoration of motor functions. It assesses motor function, sensory function and general function in patients after stroke. After the physiotherapy, there was an improvement in the performance of the test movements of the patients from both groups as a whole. The initial results from the control group: 52,9 points, t-test: - 15,21, and the growth rate 37,22. In the experimental group, after one month of applied physiotherapy and mirror therapy, a more significant improvement in the activity of the arm was reported. The results had the following values: 65,5 points and t-test: - 28,88. The growth rate was significantly better compared to that of the control group-58,89.

The applied method affected the reduction of pain, as at the beginning of the treatment in the control group, the subjective opinion was 3,2 degrees of intensity, and in the experimental group, it was 3,3 degrees of pain intensity. After the physiotherapy and the initial consultation of the patients about the strength of the pain, the results for the control group were as follows: 2,1 degree of intensity and t-test 3,79. The growth rate is - 41,51 (negative) due to a decrease in values at the end of treatment. In an experimental group, patients reported a significant reduction in pain. The final results were 1,2 degrees of pain intensity, t-test: 14,46, growth rate - 93,33.

DISCUSSION:

Based on the study, it can be noted that mirror therapy is effective and gives results when combined with other therapeutic methods to restore the effects after a stroke. This is also observed in the analysis of the Bartel Index and the Brunnstrom test. The better results reported to the patients in the experimental group can be said to be a result of the effectiveness of the mirror therapy applied to the hand, which has improved the quality of self-care and daily activities. The results of the Ashworth test again suggest that the application of mirror therapy for the upper limb in patients in the experimental group had the effect of reducing the increased muscle tone of the muscle groups of the arm compared to the control group. Thus, the results of the Mischels test at the end of the follow-up period in the patients of both groups show better values again in the experimental group. It is thought to be due to the application of mirror therapy applied to improve hand motor function, grip and fine motor skills. This makes it easier to perform more specific hand movements in everyday activities and leads to independence. The results of the Fugl-Meyer test for the upper extremities also showed higher values in the experimental group at the end of the physiotherapy procedure, including mirror therapy. The motility and the correct performance of the set tasks were optimally improved. The movements were performed accurately, smoothly, were coordinated, without delay and variability. The reduction of pain symptoms in patients who underwent mirror therapy had a positive effect on the overall recovery of the function of the affected upper limb.

CONCLUSIONS:

The development and implementation in practice of a comprehensive and modern physiotherapy program and algorithm of its application in patients who have experienced ischemic stroke lead to optimal functional recovery. The choice to apply mirror therapy to functionally improve the upper limb in patients with ischemic stroke in the late recovery period is appropriate and with good efficacy in mild, moderate and severe damage. The applied therapy is not limited in time from the stroke, i.e. it is used both in the early and late recovery period and in the chronic period. In conclusion, it can be concluded that based on the obtained statistically reliable results, it can be stated that the approbation of mirror therapy for the upper limb in the physiotherapy program in patients with ischemic stroke in late recovery period will improve functional recovery of the arm and especially will reduce the deficit in fine motor skills, which confirms the working hypothesis. The research and the achieved results give grounds to claim that the improvement of motor function and the optimal restoration of fine motor skills of the hand through mirror therapy contributes to the proper performance of daily activities, self-care and independence and quality of life.

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