

## MIRROR THERAPY IN THE REHABILITATION OF PERSONS AFTER STROKE

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**Abstract:** A clinical syndrome of vascular etiology is a stroke, which is manifested by a sudden onset of exophthalmos or a regional cerebral deficit that lasts longer than 24 hours, but can also end with a fatal outcome. The symptoms that follow a stroke, which are manifested in the extremities, depend on the artery that is affected, or more precisely, on the segment of the brain that is affected. The rehabilitation of patients after an insult is carried out through three phases, where a constant clinical assessment of the patient is required, in order to have an insight into the effects of the therapy. For rehabilitation, there are several therapeutic techniques that, depending on the degree of damage, can be included in different phases of rehabilitation. In Western countries, stroke is the third leading cause of mortality, and the leading cause of disability. In theory and practice, various treatments have been proposed for patients after a stroke, among which is Mirror therapy, during which moving images include recovery of function leading to cortical reorganization. Studies have shown that the interaction between the visual field, stretching and motor commands propagates the training of mirror neurons, giving such a cortical reorganization and the recovery of function of the patient after the insult. Aim of the research: To evaluate the effectiveness of Mirror therapy in the rehabilitation of people after an insult through a review of the literature. Work method: The search included a review of relevant databases: Medline, PabMed, Google Scholar, Research Gate. The literature review includes 5 randomized clinical trials. Results: Through a scientific review of the literature, the results of the importance and productivity of Mirror therapy in patients with stroke were presented. Multisegment therapeutic intervention, in which Mirror therapy is an indispensable part, the effectiveness of Mirror therapy has been proven. Education and recommendations, regular application of exercises and monitoring of patients. Conclusion: The effectiveness of Mirror therapy has proven to be very effective in the rehabilitation of patients after an insult. The methods and method of application of Mirror therapy improves their functional independence, which enables them to have a more successful quality of life. It has a stimulating effect on cognitive functions and sensorimotor performance, which makes it easier to carry out daily life activities, and at the same time improves the quality of life of people after strokes. Mirror therapy is a promising method because it improves the ability to maintain balance, tactile sensitivity, muscle strength and walking ability in people after a stroke.

**Keywords:** mirror therapy, rehabilitation, stroke

## 1. INTRODUCTION

Stroke or cerebrovascular insult (CVI) is defined by (WHO) as a sudden focal or, less often, global neurological deficit that lasts longer than 24 hours or leads to death, and can be explained by a cerebrovascular disorder (Coupland et al., 2018). This category of neurological disease threatens the cerebral arteries that bring blood to the brain. An insult manifests itself after only one of the blood vessels in the brain is threatened or bleeds into the brain. Deprivation of blood and oxygen causes cell death instantly in the brain, which causes the brain to fail to function properly. Once fragments of the brain are turned off from functioning, it can automatically act on body segments that are regulated. The stroke presents as a focal neurological deficit without pain. The most important part of the anamnesis is the time of onset of complaints. The deficit is determined on the NIHSS score form (National Institute of Neurological Disorders and Stroke National Institute of Health., 2016). Intravenous thrombolysis can be applied in the first few hours from the onset of the first symptoms, and the earlier the therapy is started, the better the result. Before applying the therapy, it is necessary to do a CT (computerized tomography) of the endocranium to exclude the occurrence of hemorrhage. Stroke, put in parallel with heart diseases of ischemic etiology, are key risk factors for death worldwide. Brain injury is one of the main leading causes of permanent disability, especially in high- and middle-income countries. Directly after the occurrence of a stroke, almost 80% of patients who suffered have damage to the upper and lower extremities. The complete function of the upper limbs is achieved through rehabilitation in almost 80% of patients with mild paresis, the remaining 20% of patients with severe upper limb paresis remain permanently disabled. Of those patients who have a plegic upper extremity, only half recover some of the motor functions in the paretic part six months after rehabilitation later. Only two-thirds of patients with affected lower extremity are not able to walk independently after brain insult, and after rehabilitation only half reach the function of independent walking (Hendricks et al., 2002). The severity of paresis at the beginning of the lower and upper extremities is the most important indicator of the long-term prognosis of recovery of function after a brain insult, but high variability, most likely due to the effect of therapeutic interventions (Undström et al., 2009). Up to 50% of patients are characterized by pain in the upper extremities during the first year after a brain insult, especially the presence of pain in the shoulder girdle and regional complex pain syndrome - type I. Pain after a stroke can limit daily activities and reduce the quality of life. A stroke can be just one of the main causes of hemiplegia or hemiparesis. It is a clinical syndrome of vascular etiology, which is manifested by the sudden onset of a focal or global brain deficit that lasts longer than 24 hours, but can also end in death. Neurological outcome (deficit) is actually an indicator of which area of the brain is affected. Parenchymal damage in the anterior circulation causes unilateral disturbances, while damage in the posterior circulation manifests itself bilaterally and creates disturbances in the state of consciousness (Eissa et al., 2012).

## 2. MATERIALS AND METHODS

Systematic literature search of relevant databases, Medline, PabMed, Google Scholar, Research Gate koje je usklađeno u okvirima sistema of PRISMA (Moher D., 2009) by keeping the main search keywords: mirror therapy, rehabilitation, stroke from 2011 to 2020. Articles were also selected from references of relevant articles, by searching on different websites of magazines. Without any restrictions in terms of time period, vocabulary, religiosity, all those studies that will cover certain criteria will be included: (1) Ispitanici oba pola; (2) rehabilitation; (3) stroke; (4) mirror thrtapy. Animal studies, records and case series, conference abstracts, or undated letters were excluded.

## 3. RESULTS

Through a scientific review of the literature, the results of the importance of the use of mirror therapy in kinesitherapy of people after a brain insult. 286 papers, published in the period from 2011 to 2020, extracted from 4 databases, were taken into account. After finishing the copies of studies and publications that are irrelevant, 156 papers were further processed, while only 24 papers were read in full, only 5 papers satisfied the 4 criteria for implementation in the scientific literature review. All studies were randomized controlled trials . In the total number of 5 studies, 165 respondents were included, to evaluate the effectiveness of mirror therapy in kinesitherapy of people after brain insult. The review of these 5 studies showed that there is a great importance of the use of mirror therapy in rehabilitation after a brain insult. Picture number 1.

Figure 1. Prism diagram of research included in the review

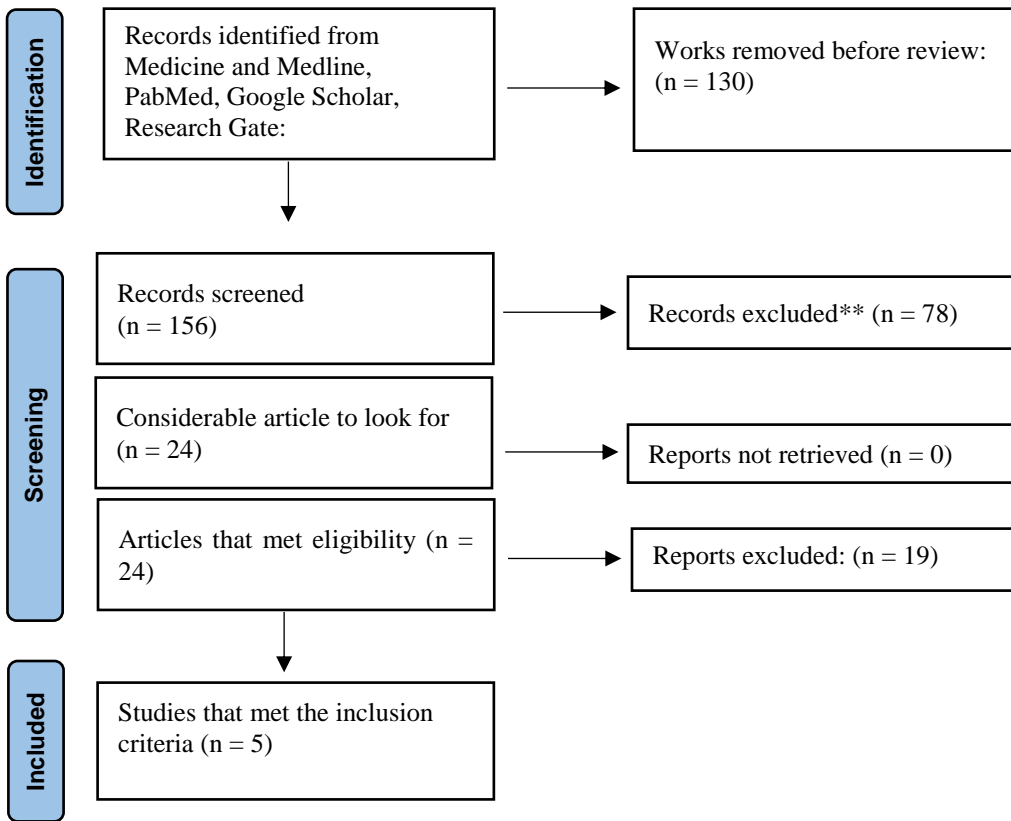


Table 1. Summary of study characteristics

Author(s).	Name of the study	Research objective/s	Research method/s	The results	Conclusion
Colomer et al., 2016	Effect of mirror therapy in chronic stroke in patients with poor upper extremity dysfunction	Evaluating the success of mirror therapy with stroke that is chronic with poor upper extremity function impairment.	31 respondents participated in the research and were segmented into experimental and control groups using the method of random selection. Patients were measured before and after treatment with motor function test Fugl-Meier analysis and Nottingham sensory assessment.	Improvement of motor function was recorded in both groups at the time interval. No differences were observed in kinesthesia and stereognosia. The scientific group also showed a drastic increase in tactile sensation.	Compared to passive immobilization, mirror therapy has a positive effect on light touch, and at the same time provides motor improvement.

*Table 2. Summary of study characteristics*

Author(s).	Name of the study	Research objective/s	Research method/s	The results	Conclusion
Lee D and Lee G., 2019	Motor function, gait and balance in combination with electrical afferent stimulation in chronic stroke, the effect of mirror therapy.	The significance of this study was the effect of electrical afferent stimulation with the application of mirror therapy on gait, balance and motor function among patients with chronic stroke.	30 respondents, who were selectively divided into scientific and control groups. The patients of the scientific group had electrical afferent stimulation and mirror therapy, while the subjects of the control group had sham electrical afferent stimulation and sham mirror therapy. Motor function was calculated with a manual dynamometer and a modified Ashworth scale, balance was measured with the Berg scale, Gaitrite was measured at the beginning and end of the treatment, which was responsible for walking.	Significant differences were recorded in the experimental group in muscle strength, modified Ashworth's scale and Berg's scale found a positive effect for balance, speed, cadence and stride length.	The results prove that mirror therapy with electrical afferent stimulation can greatly increase muscle strength, balance and gait in people after stroke.

*Table 3. Summary of study characteristics*

Author(s).	Name of the study	Research objective/s	Method/s research	The results	Conclusion
Michielsen ME. et al., 2011	Cortical reorganization and motor recovery after combined with mirror therapy	This study aims to evaluate all clinical effects in home treatment with mirror therapy.	40 subjects with chronic stroke participated in the research. Divided into experimental and control groups. The results proved that Fugl-Meier (FMR) motor assessment, pain, spasticity, grip strength, manual use in activities of daily living.	FMR increased more in the science group than in the control group. Achieved results - FMPN found changes in the balance of activation within the motor cortex in the primary part according to the affected hemisphere only in the scientific group. No changes were found in other outcome measures.	Effectiveness is proven. This research linked mirror therapy with cortical reorganization.

*Table 4. Summary of study characteristics*

Author(s).	Name of the study	Research objective/s	Research method/s	The results	Conclusion
Kim MK et al., 2016	Balance ability in people with subacute stroke combined with mirror therapy.	The aim of this study was to prove the effect of mirror therapy on the balance of people with subacute stroke.	34 patients, who were assigned to scientific and control groups. The scientific group of patients had, in addition to standard rehabilitation, mirror therapy, while patients in the control group received sham mirror therapy in addition to standard therapy. The results were measured using an index balance and obtained using a balance calculation system.	A big difference was recorded in the research for the overall index of stability, medial and lateral stability in the scientific and control groups.	The improvement of balance in patients with subacute stroke was due to the use of mirror therapy.

*Table 5. Summary of study characteristics*

Author(s).	Name of the study	Research objective/s	Method/s research	The results	Conclusion
<b>Madhoun HY et al., 2020</b>	Increasing upper extremity motor function in patients with subacute stroke in combination with mirror therapy	To evaluate the effect of mirror therapy compared to occupational therapy, with moderate and significant functional impairment of the upper extremities that affects motor function and daily life activities in patients with subacute stroke.	30 respondents who were divided into two groups. In addition to occupational therapy, the first group had MIRROR therapy, while the control group had only occupational therapy. Both groups had standard therapy. The following were used for the results: Modified Ashworth scale (MAC) Modified Barthel index (MBI) Brunnstrom assessment. Fugl-Meier estimation.	Both groups proved that there is improvement in activities of daily life, recovery of motor function. The results were significantly better in the group where occupational therapy was combined with mirror therapy, than occupational therapy alone. Spasticity is slightly reduced in certain muscle groups.	Mirror therapy is an effective method for improving functional recovery in patients with subacute stroke.

#### 4. DISCUSSION

This review article included 165 patients after stroke. An important aspect in rehabilitation is improving function after stroke to improve functional independence. In the research conducted by Thieme H and colleagues, they identified arguments that mirror therapy increases motor function, motor impairments and functionality in everyday life. They found reduced pain after a stroke and an increase in impaired motor function half a year after the end of rehabilitation (Thieme H et al., 2018). Research by Gandhi DB et al. mirror therapy facilitates the corticospinal pathway, which concludes that there is an increase in motor function resulting in a stronger image of mental and motor learning induction enables recovery from neglect. Mirror therapy strengthens the activity in the somatosensory fields consisting of the primary and secondary zones, which results in increased attention. It also becomes more aware of the feedback sensory data and the removal of the remembered unused affected limb . (Gandhi DB et al., 2020) Zhuang JY. states that the use of mirror therapy as an adjunctive method of therapy to usual care can reduce motor impairment of partially amputated upper limbs. There was also an improvement in the daily functions of stroke patients, as well as an improvement in manual dexterity. (Zhuang JY et al., 2021) Nogueira NGHM results obtained. and associates that mirror therapy is a simple and economical method of application in rehabilitation, which plays an important role in improving motor and sensory functions, especially in comparison with the standard protocol. (Nogueira NGHM et al., 2021). Choi HS and colleagues have reached the clinical significance of the results of the research that it can be used to increase the movement function of the upper extremities in patients who have experienced a brain insult. The programs that are used are virtual reality games and the implementation of the mirror therapy method is simple, and it is financially significant because no expensive equipment is required. Mirror therapy is performed looking forward, while the application of standard mirror therapy results in discomfort in the neck that is of a minor nature and can be applied to patients with significant paralysis of the affected limb. (Choi HS et al., 2019). Thieme H. and co-workers in the results after five weeks did not prove big changes in the group of patients for motor function which was ( $P > 0.05$ ). Before the test, a difference is observed for the application of the Fugl -Meyer test: individual mirror therapy: 3.4 and 3.2. Also, a large impact on the visual-spatial neglect of patients in individual mirror therapy can be proven in relation to the sham group for examination ( $P < 0.01$  ) . Mirror therapy is a very important method with great evidence of effectiveness for the use of patients with cerebral insults who have severe hand paresis as a result. These authors conclude that there is no effect on the sensory and motor function of the upper extremities, the usual functional activities of life. A positive effect on visual spatial neglect has been proven . (Thieme H et al., 2013).

#### 5. CONCLUSIONS

Mirror therapy significantly improves cognitive functions and motor performance, which makes it easier to carry out daily life activities, and at the same time improves the quality of life of people after strokes. Mirror therapy has

positive effects on functional recovery, which contributes to the overall functionality in the daily life of people after strokes. Mirror therapy is an effective intervention for unilateral and visuospatial neglect in people after strokes. Mirror therapy is a promising method because it improves the ability to maintain balance, tactile sensitivity, muscle strength and walking ability in people after a stroke.

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