Journal of Novel Physiotherapies

Research Article Open Access

Differences between High Intensity and Low Intensity Mirror Therapy for Hand Functions of Patients with Cerebrovascular Accidents

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Abstract

Background: Stroke is the major cause of disability and loss of hand functions which affects the functioning of impaired limb. One of the new therapeutic approaches is the mirror therapy which is found to be effective and easily available in India. This treatment can be used by all rich and poor people as it is easily available. There are different protocols of mirror therapy available however evidence is lacking with comparison between high intensity and low-intensity protocols. Thus, the aim of the study is to compare these two protocols of mirror therapy with hand functions in patients with Cerebrovascular Accidents.

Methods: The study was conducted at Mahatma Gandhi Mission Physiotherapy Rehabilitation and Fitness Centre, Aurangabad for four weeks. Twenty patients were divided into two groups as Group A as low intensity mirror therapy group where participants were given treatment for 15 minutes twice a day, 10 repetitions, five times a week for 4 weeks. Group B as high intensity mirror therapy group where participants were given treatment for 30min twice a day, 20 repetitions five times a week for 4 weeks. Data was collected and analysis was done using SPSS.

Results: There was significant difference found in high intensity mirror therapy group as compared to low intensity mirror therapy. The range of motion of wrist joint with p value for flexion (0.0453), p value for extension (0.0228), p value for radial deviation (0.2321), p value for ulnar deviation (0.171) and metacarpophalangeal joint with p value for flexion (0.0808), p value for extension (0.0094), was significantly improved in high intensity mirror therapy group as compared to low intensity mirror therapy group.

Conclusion: High intensity mirror therapy program enhanced the wrist and hand joint range of motions significantly indicating a preferred technique for the rehabilitation of the upper extremity in sub-acute population.

Keywords: High intensity, Low intensity Mirror therapy, Sub-acute stroke

Introduction

Cerebrovascular accident (CVA) or stroke is the sudden loss of neurological function caused by an interruption of blood flow to the brain [1]. The motor deficit is characterized by paralysis (hemiplegia) or weakness (hemiparesis), typically on the opposite side of the body to the side of the lesion. Impairments may resolve spontaneously as brain swelling reduces within 3 weeks, however, residual neurological impairments may be maintained causing disability.

There are 3 main types of strokes, including Anterior cerebral artery syndrome, Middle cerebral artery syndrome and Posterior cerebral artery syndrome. According to the American Heart Association, the warning signs of stroke are sudden numbness or weakness of the face arm or leg especially on the one side of the body, confusion, trouble speaking or understanding, trouble seeing in one or both eyes, trouble walking, dizziness, loss of balance or coordination, severe headache with no known cause.

The middle cerebral artery (MCA) supplies entire lateral aspect of cerebral hemisphere (frontal, temporal and parietal lobe) and subcortical structures including internal capsule (posterior portion), corona radiate, globus pallidus, caudate nucleus, putamen. Most common characteristics of MCA syndrome are contralateral spastic hemiparesis, sensory loss of face upper extremity and lower extremity, with the face and upper extremity, more involved than the lower extremity. Upper extremity (UE) function is impaired due to the involvement of primary motor area, medial aspect of the cortex and internal capsule. If there is a right hemispheric lesion, then there is a left side hemiplegia/hemiparesis and sensory loss and vice versa [2].

In the patients with CVA, upper limb paralysis is the most common symptom; it causes a restriction in the functional activities in the impaired UE which leads to long term or permanently impaired function of the extremity. Hemiplegia leads to loss of function which results in decrease participation in activities of daily living; thus, affecting the quality of life [2].

There are different treatment options for improving UE function; mirror therapy is one with potential [3]. Mirror therapy was first described by Ramachandran et al. as an effective method for relieving residual limb pain for individuals who sustain an amputation [4]. Mirror therapy has been found to improve range of motion (ROM), speed and accuracy of the movement, grip strength and improves motor function and motor recovery in patients with chronic stroke [5].

In addition, it is reported that in acute patients with stroke, mirror therapy enhances the motor function of the distal part of the upper limb. A systematic Cochrane review showed that mirror therapy after stroke is effective in improving short and middle term motor function, activities of daily living and in reducing pain especially in patients with complex regional pain syndrome. Mirror therapy was

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Received May 08, 2020; **Accepted** June 10, 2020; **Published** June 17, 2020

Citation: Palaskar P (2020) Differences between High Intensity and Low Intensity Mirror Therapy for Hand Functions of Patients with Cerebrovascular Accidents. J Nov Physiother 10: 430.

first used as a possible option to help the stroke patients to rehabilitate the motor function of the affected UE. Mirror therapy demonstrated improvement of ROM of affected hand, reduction in the pain, posture. There were positive outcomes in the hand and arm of patient with CVAs during ten weeks follow up phase [6].

In patients with CVA, hand function improves after mirror therapy in addition to a conventional rehabilitation program. Mirror therapy does not affect spasticity. However visual feedback, provided by the mirror therapy, helps in improving motor performance outcome. Mirror therapy can provide some form of access to a body part that is otherwise not accessible [7].

The use of mirror therapy was found to be beneficial in the rehabilitation of patients with CVAs. Mirror therapy in combination, motor copy and forced- use, help in improving the function of the impaired limb. In mirror therapy, the patient had to perform a synchronous bimanual movement while looking at unimpaired left or right arm and its reflection in the mirror. Initially, there is facilitation of the 'motor copy' strategy and afterwards the 'forced use' strategy is used to improve the function [8].

The use of the unaffected extremity produces a reflection in the mirror and it is perceived as affected extremity and it is perceived as a paralytic limb. This visual perception can be therapeutically beneficial in improving the perception of the affected limb. The mirror therapy helps in activating motor neurons, which may also be activated when observing others perform movements and during the mental practice of motor task. The areas of the brain that are associated with enhanced self-awareness, spatial attention, and recovery activated [9].

There are different protocols of mirror therapy available, but no comparison found between the protocols, hence there is a need to compare the statistical difference of high intensity and low-intensity mirror therapy. High-intensity protocol is given by Lee MM, Cho H, Song CH, and Low-intensity protocol is given by Andreas Stephan Rothgange, Susy M Barun [10]. So, this study is aimed to see whether there is any significant difference between the results of high intensity and low intensity mirror therapy protocols in stroke patients.

Methodology

The 20 subjects of this study were patients of CVA with upper extremity deficits who were outpatients coming to MGM Physiotherapy Rehabilitation and Fitness centre, Aurangabad. Sample size was calculated based of prevalence of patients with CVA in MGM Physiotherapy rehabilitation and fitness centre, an outpatient setup, Aurangabad. Ethical approval was taken by institutional ethical committee. The written consents were taken from all participants. Random sampling was done by lottery method. Total 25 subjects assessed for study, 3 were not able to fit in the inclusion criteria (medically unstable vitals, were unable to follow commands, visiuoperceptual disorders, etc). Two patients dropped out the study so total 20 subjects of stroke included in this study. The patients were divided into two equal groups (10 patients in each group) as group A (low intensity exercise program), group B (high intensity exercise program).

Inclusion criteria were: 1) Patients having stroke within the previous 6 months. 2) Patients able to understand and follow simple verbal instructions (Mini mental state examination score >21). 3) Patients able to focus at least for 10mins into mirror reflection and to follow the instruction of therapist (the patient should be eligible for cognition and verbal abilities). 4) Patients able to see the unaffected extremity. 5) Patient able to sit in wheelchair and chair during treatment session. 6) Patients having Brunnstrom score between grade 1 and 4 for upper limb. 7) Patient without any deformities or injury to non-affected extremity.

The exclusion criteria were: 1) Patients with orthopedic disorders, apraxia, an upper limb fracture or peripheral nerve injury 2) Uncooperative patients. 3) Patients with mini mental state score <21. 4) Patients with visual impairments.

Procedure

After considering the inclusion and exclusion criteria, 20 selected participants, were randomly assigned to either the group A (n=10) or group B (n=10). Informed consents were taken from each participant. Before intervention, patients were explained the objective, effects and procedure of mirror therapy. Firstly, the single therapist assessed the motor performance of the hand by Brunnstrom scale and range of motion of wrists and fingers were recorded. Then therapist visually or verbally demonstrated the motor exercises so that patient should execute the movement. Patient is made to sit on a stool, a mirror was positioned perpendicular to the patient's midline. All jewelry was removed from arms and the affected hand was put into a mirror box, whereas the unaffected hand was placed on the front of the reflective surface. The uninvolved UE of the patient was put in front of the mirror so that it can make a visual image by reflecting itself. By doing this, the patient visualizes illusioned limb instead of actual limb. The therapist told the patient to focus only on what is on the mirror. Patients were told to do exercises like flexion and extension movements of fingers and wrist for first two weeks, then combination of movements like wrist extension with finger extensions were added. The patient was told to try to facilitate a "Mirror Illusion" (mirror imagine perceived as the impaired limb) by matching the position and image of the unimpaired limb to the affected side. For example, the unimpaired limb should be positioned in a similar position as the impaired limb, as this facilitates the intensity of the mirror illusion. Then treatment was progressed to start with the range of motion that can also be achieved in affected side. Group A participants were given treatment of 10 repetitions of each movement for 15 minutes twice a day, five times a week for 4 weeks. Group B participants were given treatment for 20 repetitions of all movements for 30 minutes twice a day, five times a week for 4 weeks. The same therapist reassessed the motor performance of the hand by Brunnstrom scale and range of motion of wrists and fingers [11].

Data Analysis

For the demographic profile, baseline data was matched in terms of age, gender and hand dominance of UE. The findings of the motor performance of the hand by Brunnstrom scale and range of motion of wrists and fingers for pre and post-treatment were recorded and this data was analyzed using SPSS version 22.0 software package. Descriptive statistics were used for the subject's demographic characteristics. The p-value was set at 0.05.

The paired 'T' test was used to do intra group pre and post-treatment analysis of Brunnstrom scale and range of motion of wrists and fingers for. Unpaired 'T' test was used to perform inter group analyses for the post treatment values of Brunnstrom scale and range of motion of wrists and fingers.

GENDER	GROUP-A	GROUP-B
MALE	3	8
FEMALE	7	2
TOTAL	10	10

Table 1: Distribution of males and females in group A and group B.

AGE	GROUP-A	GROUP-B
≤30	0	1
31-50	0	3
51-60	0	0
60-70	5	4
>70	5	2

Table 2: Age wise distribution of patients in Group A and Group B.

DOMINANCE OF HAND	GROUP-A	GROUP-B
RIGHT	7	4
LEFT	3	6
TOTAL	10	10

Table 3: Distribution of patients in Group A and Group B based on hand dominance.

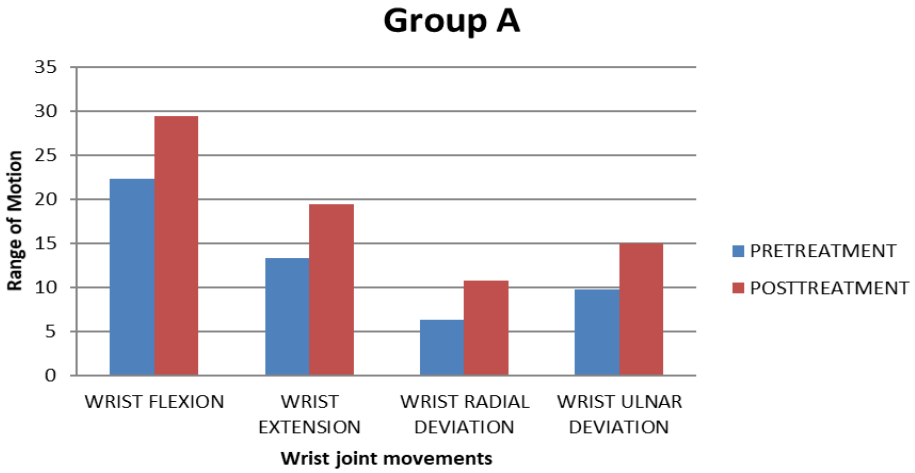

Figure 1: Showing pre and post treatment changes in wrist ROM in Group A.

Wrist Joint	Range of motion of joint	Pre *Vs* Post treatment Mean difference	T- Value	P-Value
GROUP-A	Flexion	-7.099	5.1524	0.0006
	Extension	-8.099	1.0639	0.3014
	Radial deviation	-4.5	6.7002	0.001
	Ulnar Deviation	-5.199	4.7122	0.0011
GROUP-B	Flexion	-12.6	4.9266	0.0008
	Extension	-11.29	4.4411	0.0016
	Radial Deviation	-6.199	11.625	0.0001
	Ulnar Deviation	-7.5	10.4341	0.0001

Table 4: Shows the distribution of pre-treatment versus post-treatment values of mean difference of range of motion in wrist joint in Group-A and Group-B. This table indicates improvement in wrist joint range of motion in both groups post treatment. But Group B is showing more improvement as compared to Group A.

Results

Out of 25 subjects assessed for study, 3 were not able to fit in the inclusion criteria (medically unstable vitals, were unable to follow commands, visio-perceptual disorders etc). In addition, two patients dropped out the study, leaving a total of 20 subjects. The patients were divided into two groups randomly by lottery method (10 patients in each group) as group A (low intensity exercise program) and group B (high intensity exercise program). The baseline data was matched in terms of age, gender and hand dominance. (Tables 1-3 & Figures 1 and 2) (Table 4 & Figure 3) (Figure 4 & Table 5).

Discussion

A number of studies that investigated the effect of mirror therapy on the upper limbs in Patients with CVA have also reported

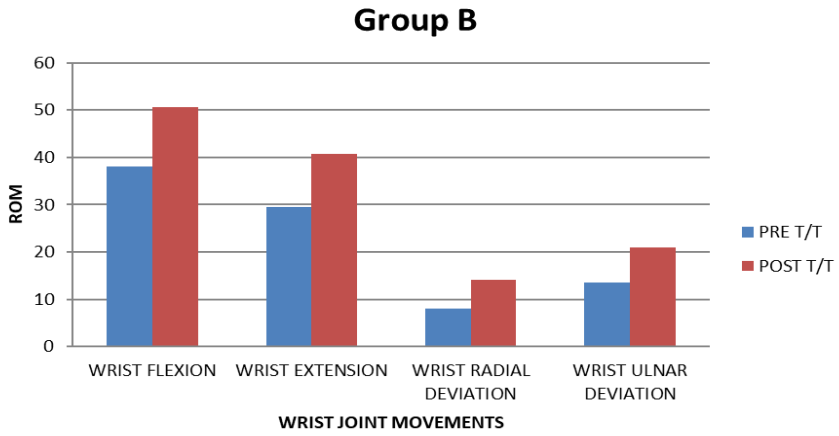

Figure 2: Showing pre and post treatment changes in wrist ROM in Group B.

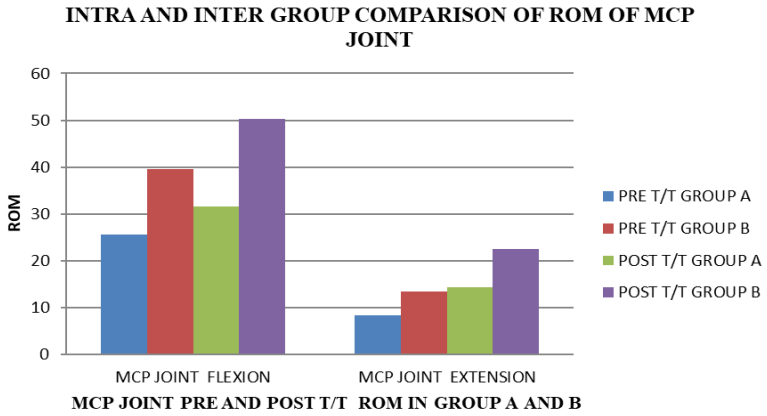

Figure 3: Intra and Inter group comparison of ROM of MCP joint.

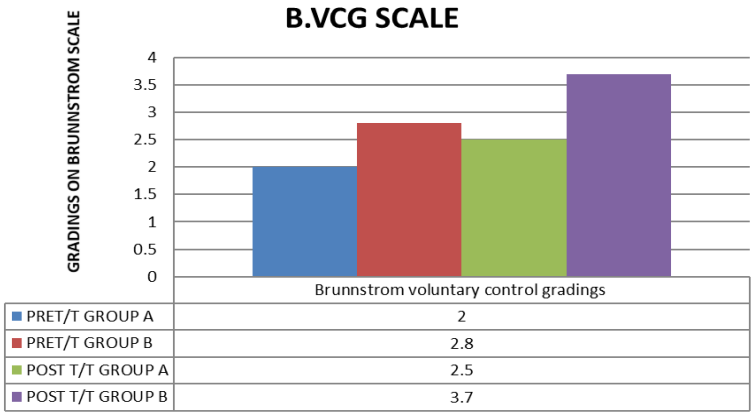

Figure 4: Showing inter and intra group comparison of Brunnstrom voluntary control grading indicating more improvement in Group B as compared to Group A.

improvements in the range, speed, and accuracy of movements as well as improvements in grip strength [3,4,12,13]. Furthermore, in another study, self-care capacity in patient with acute CVA, improved by 21% and their motor functions for motor items of the Functional Independence Measure scale improved by 36% [14]. In the present study, the effects of high and low-intensity mirror therapy were studied to determine ROM values of and voluntary control grading among the patients with CVAs. Brunnstrom's hand function scale was used to obtain subjective information about ROM of wrist and fingers by mirror therapy in patients with CVA. The study was conducted with 20 subjects the which were divided into two groups accordingly as low intensity group A and high intensity as group B. Brunnstorm hand

recovery scale was used as an outcome measure. Another researcher Leem.et.al, in his study in 2012 found that mirror therapy program is an effective intervention for upper limb motor recovery and motor function improvement in acute stroke patients. He also found that Brunnstrom upper limb motor recovery stage score improved by 100% and hand function recovery improved by 113% through the use of mirror therapy [10]. In our study, we found that mirror therapy intervention program is effective in improving hand function in patients with acute stroke. Those patients who were treated with high-intensity mirror therapy showed more improvement than the patients treated with low-intensity mirror therapy. In group A, P-value of wrist flexion is 0.0006,extension is 0.3014, radial deviation is 0.0001 and ulnar deviation is 0.0011.Another study done by Yavuzer et al. stated the effectiveness of upper limb motor therapy combined with the standard rehabilitation program in sub-acute stroke and showed an increase of 36% in both Brunnstrom upper limb motor recovery stage and range of motion of wrist and fingers [9]. In our study high-intensity mirror therapy shows significant improvement than the low-intensity mirror therapy in Brunnstrom hand motor recovery stage [15,16].

The results obtained in this study can be explained by certain process that triggers brain activation by mirror therapy. The passive observation and imitation of an action through mirror therapy activate motor neurons in cerebral cortex and spinal cord.

Conclusion

Mirror therapy could become a standardized form of hand rehabilitation therapy. But more research is required on program components, intensity, application time and duration etc. Mirror therapy may prove to be good treatment option if proper treatment protocol is decided. The high intensity mirror therapy program may be more beneficial in rehabilitation of hand functions in patients with CVA. As the sample size was small, further study is needed in this area with larger sample size. Fine motor activities and functional performance of hand was not assessed in this study so further study is needed to conclude the improvement in functional performance of hand with high intensity mirror therapy protocol. Clinical implication of the given study is that high intensity mirror therapy treatment protocol may be more beneficial for improvement in hand function in patients with CVA.

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