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COMPARISON OF MIRROR THERAPY VERSUS MUSCLE STRENGTHENING EXERCISES FOR ARM REHABILITATION IN PATIENTS WITH SUB-ACUTE STROKE: A RANDOMIZED CONTROLLED TRIAL

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HIGHLIGHTS:

- A quasi-experimental study of 35 patients in the sub-acute stage was conducted to compare the effects of mirror therapy on strengthening exercises for arm rehabilitation.
- The sample was divided into two groups; the experimental group of stroke patients receiving mirror therapy with baseline treatment and the conventional group of stroke patients receiving baseline treatment.
- Mirror therapy has a significant role in improving motor function and strength in the upper extremity, especially as an adjunct treatment to conventional therapy in patients with sub-acute stroke.

ABSTRACT

Stroke is the leading cause of brain damage and disability. Rehabilitation measures help to restore lost abilities and improve the quality of life. Motor function deficits due to stroke affect the patient's mobility and cause limitations in daily life activities. Rehabilitation training is one of the most effective ways to reduce motor impairments in stroke patients.

OBJECTIVE: To find the effects of mirror therapy compared with muscle strengthening exercises for arm rehabilitation during the sub-acute stage of stroke.

MATERIAL & METHODS: A quasi-experimental study of 35 patients in the sub-acute stage was conducted to compare the effects of mirror therapy on strengthening exercises for arm rehabilitation. The sample was divided into two groups; the experimental group of stroke patients receiving mirror therapy with baseline treatment, and the conventional group of stroke patients receiving baseline treatment using a non-probability purposive sampling technique was used.

RESULTS: At baseline patients of both groups showed no significant difference regarding both treatments shown by the action research arm test and Fugyl Meyer assessment scale.

CONCLUSION: The study concluded that mirror therapy has a significant role in improving motor function and strength in the upper extremity, especially as an adjunct treatment to conventional therapy in patients with sub-acute stroke.

KEYWORDS: mirror therapy; strengthening exercise; stroke rehabilitation

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INTRODUCTION

Stroke is one of the most common reasons for disability. It causes deficits in motor function, impairs patient mobility and their limitation in daily life.1 Physical rehabilitation is the most effective way to reduce motor impairment in stroke patients. A variety of rehabilitation techniques are present the main aim used is to be promoting the function of the affected upper limb in patients having a stroke, e.g. constraint-induced movement and robot-assisted therapy. Mirror therapy (MT), a simple, cheap rehabilitation method, that already been an

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excellent approach to rehabilitation for motor function recovery in the upper extremity among stroke patients.[2]

Ramachandran was among the first to describe mirror therapy as an effective method to relieve pain in the amputated limb. In this study, a mirror was placed on the table unaffected arm in front of the mirror and the paretic side was placed behind the mirror. Patients receive visual feedback from the arm which is not affected while watching its movement in the mirror. This is placed to give patients a feeling of restoration of their affected arm. This study is important because it aims to measure the exclusive role of mirror therapy after hemiparesis in restoring or improving motor function of the upper limb in patients after stroke. The effect size of mirror therapy is a major consideration. Mirror therapy is among visual imagery techniques in which visual stimuli are conveyed to the brain by using a mirror. The brain utilizes observations of unaffected parts of the body while they are performing movements and influence the parts which are affected.[3]

The survivors of strokes with upper arm weakness are instructed that the weak arm should be hidden under a triangular box with a covered top surface. In the next step, patients move their stronger arm as per instructions of the clinician and observe movement in the mirror box. This gives a signal to the brain as if a weaker arm is moving with a strong force, although patients know about the purpose and status of the movement they are doing. This gives a false impression to the brain that a weaker arm is stronger. After the termination of a mirror therapy session, the patient can use the paretic weak arm with stimulation from the corresponding brain area.[4]

Studies to investigate outcomes of mirror therapy versus conventional methods of treatment for improvement of the function of the upper limb after hemiplegic stroke.[5] The main outcome variables were gross manual strength, function limitation and muscle performance. Mirror therapy proved to be effective in both acute and chronic types of stroke.[6] Mirror therapy was used as an additional treatment to conventional physical therapy and showed a marked role in improving the quality of evidence and upper limb function. Evidence regarding lower extremities showed less role of mirror therapy.[7]

The repetitive muscle contraction is defined as strength training.[8] Electrical feedback with or without stimulation, progressive resistive training and mental practice include further ways of strength training.[9] After a stroke, the hemiplegic side becomes weak with mild to a severe loss of strength as compared to the unaffected side or in comparison to other healthy individuals around. A small proportion of descending cortical tracts have a role in the non-paretic extremity or side of the body. These tracts may originate from the site of the lesion and remain on the same side. Mostly after a stroke, the sedentary style of life prevails. This disuse mostly become a contributing factor in diminished strength.[10]

There is an important role of progressive resistive exercise programs in improving activity limitation, impairments and participation restrictions after the cerebrovascular accident and also have a role in improving muscle performance musculoskeletal in neurological stroke.[11] The upper limb training was intensified by weight training and exercises with and without inducing a task-oriented exercise program In patients of chronic stroke with mild to moderate musculoskeletal impairments, strength training has been proven with markedly important in the restoration of function.[12] The study aimed to find the effects of mirror therapy in comparison with muscle strengthening exercises for arm rehabilitation during the sub-acute stage of stroke.

MATERIAL AND METHODS

This study was a single-blinded, quasi-experimental study conducted in the Physiotherapy

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department, at DHQ Hospital, Jhang. It was completed within the time duration of six months after the approval of the synopsis. The sample was divided into two groups; the experimental group of stroke patients receiving mirror therapy with baseline treatment, and the conventional group of stroke patients receiving baseline treatment. Non-probability purposive sampling technique was used.

Participants who fulfilled the inclusion criteria were requested to take part in the study. The total sample size was calculated as 38 using Epitool, with a confidence level of 95% and a margin of error of 5%, out of these participants 4 patients did not continue the treatment, so only 34 patients were analyzed in the study.[13]

After fulfilling the inclusion and exclusion criteria the participants were requested to participate in the study. Written consent was taken and 34 participants were randomly allocated into two groups equally (17 in each group). The interventions were based on outpatient rehabilitation programs in both groups. The study participants were blind about groups and treatment protocol. Patients were evaluated at baseline and after four months of treatment. To measure the improvement in motor recovery, the following measures are recorded:[14]

- Motor Index for the assessment of the motor function of the upper limb
- Fugyl Meyer Assessment scale for upper limb (FMA-UE)15
- Action Research Arm test (ARAT)

ARAT is a 19-item measure that is divided into four subgroups (grasp, grip, pinch and gross arm movement).[16] Both the mirror therapy and the conventional group received four weeks of treatment with 30 minutes' sessions four days a week. The conventional group receives a strengthening exercise regime and the experimental group receives mirror therapy in addition to conventional treatment. The mirror therapy group receives an additional 30-minute session two days a week. Patients were seated on a chair and a mirror is placed vertically alongside the patient. Under supervision, the patient observes the reflection of an unaffected limb in the mirror. Flexion and extension of the shoulder and elbow, supination and pronation at the wrist. Speed and repetitions were modified according to the patient.

The data were analyzed through SPSS V.20. Mean and standard deviation for numeric variables such as age and sex. Differences between single variables in the group were evaluated by Wilcoxon's rank test.

RESULTS

In this study, the male count was 21 and the females were 13. The age range of both groups was between 40 to 55 years. The mean score was 30.88±5.41 for the conventional group, whereas in the experimental group the mean score was 32.7±8.57 (Table 1). The mean scores for ARAT were 35.35±7.01 and 46.35±5.62 for the conventional and experimental groups respectively (Table 1).

Table 1: ARAT scores

Group			Mean	Std Deviation	Std Error Mean
Conventional Group	Pair 1	Pre-treatment ARAT	30.88	5.41	1.31
		Post-treatment ARAT	35.35	7.02	1.70
Experimental Group	Pair 1	Pre-treatment ARAT	32.71	8.58	2.08
		Post-treatment ARAT	46.35	5.61	1.36

The mean score for FIM test at pre-treatment level was 29.23±4.57 for the control group, whereas in the experimental group the mean score was 27.0±5.01. The mean score for FIM test at post-treatment level was 34.59±3.81 for the control group, whereas for the experimental group the mean score was 36.17±4.67 (Table 2).

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Table 2: FIM Self-Care Scores

Group			Mean	Std Deviation	Std Error Mean
Conventional Group	Pair 1	Pre-treatment FIM Self-care Score	29.24	4.576	1.110
		Post-treatment FIM Self-care Score	34.59	3.809	0.924
Experimental Group	Pair 1	Pre-treatment FIM Self-care Score	27.00	5.012	1.216
		Post-treatment FIM Self-care Score	36.18	4.667	1.132

The mean score for FUA-UE scale at pre-treatment level was 30.17 and SD was 9.13 for the control group, whereas in the experimental group mean score was 34.41 and SD was 7.49 (Table 3). Comparison of means at pre-treatment, using pair samples t-test.

Group statistics for FUA-UE scale at post-treatment level:

The mean score was 37.00 and SD was 7.322 for the control group, whereas for the experimental group mean score was 48.70 and SD was 2.312 (Table 3). Comparison of means at post-treatment, using pair samples t-test.

Table 3: FUA-UE Scale

Group			Mean	Std Deviation	Std Error Mean
Conventional Group	Pair 1	Pre-treatment PUA-UE	30.18	9.13	2.21
		Post-treatment PUA-UE	37.00	7.32	1.78
Experimental Group	Pair 1	Pre-treatment PUA-UE	34.41	7.49	1.82
		Post-treatment PUA-UE	48.71	2.31	0.56

Table 4: Wilcoxon Signed Rank Test ARAT

	N	Std Deviation	Min.	Max.	Percentiles		
					25th	50th (Median)	75th
Pre-treatment ARAT	34	7.12	21.0	45.0	26.0	30.0	38.0
Post-treatment ARAT	34	8.38	27.00	54.00	32.0	43.0	46.0

Table 5: FIM scores

	Mean	Std Deviation	Min.	Max.	Percentiles		
					25th	50th (Median)	75th
Pre-treatment FIM Self-care Score	28.12	4.86	14.0	35.0	25.0	28.5	32.0
Post-treatment FIM Self-care Score	35.38	4.27	29.0	43.0	31.0	35.0	39.0

DISCUSSION

Mirror therapy was novel to patients and also to assessors and supportive staff of this study. Due to this factor, there was a high level of interest and motivation toward this treatment. The findings suggested that mirror therapy played a great deal of role in improving upper arm function after hemiplegic stroke. There was extensive statistical analysis which covered descriptive statistics, paired sample statistics and Wilcoxon rank testing due to some non-parametric variables and data. Paired sample statistics were performed for all scales such as the Action Research Arm test a 19-item measure that is divided into four subgroups (grasp, grip, pinch and gross arm movement), Motor Index for the assessment of the motor function of the upper limb, Fugyl Meyer Assessment scale for upper limb and ARAT was chosen as the main outcome measure.[17]

The main advantage of performing exercise based on the mirror therapy approach, is the muscles react to activate more muscles. With time muscles attain their strength to maintain function

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specifically affected muscles of the upper limbs. Mirror therapy involves more groups of muscles without even loading weight. Like this, affected muscles get activated and overall performance got better. Measures of brain activity such as EEG and measures of muscle activity such as EMG depicted that there is the production of enough electrical activity when the same muscle is exercised based on mirror therapy.

Hunter et al, in 2018 also conducted a study in which the role of functional strength training was investigated for improvement in recovery of the upper limb. In comparison to functional strength training, movement performance therapy was used. Frequency, time and type of exercise were specified for sessions. Both techniques were given to patients and facilitation or sensory techniques were incorporated for accurate movement. Action Research Arm Test was used as an outcome measure. This study concluded that both techniques were equally effective. In the next phase, when techniques were combined with mirror therapy and crossed over, each time the mirror therapy group of patients performed significantly better. However, there was no correlation between upper limb recovery and baseline neurological measures.[6]

Chen et al conducted a study in 2015 intending to compare isokinetic and isotonic resistance training programs for increasing strength, quality of life, cytokines and functional capacity in patients after the hemiplegic stroke of six-month onset. This study concluded that early resistance training can be helpful in post-stroke patients for functional strength. The results compared to many studies in a systematic review showed much of similarities and fewer differences.[18]

In this review mirror therapy was used for improving function by placing a mirror in the patients' midsagittal plane to reflect movements of the unaffected side not involved in the stroke. The outcomes of mirror therapy were compared with conventional or placebo type of treatments. Visuospatial neglect, pain and daily living activities were assessed. Randomized straight and randomized cross-over, both designs were considered. Mirror therapy alone and especially adjunct therapy with conventional therapy proved to be a lot more effective. Pain, daily activities, impairment and motor function was evaluated in these studies. Methodological details in reporting were missing in most studies like in Thieme et al, in 2018.[19]

There was another study supporting the findings of the current study that was conducted to evaluate the feasibility of mirror therapy and potential outcomes after stroke. Although it was a pilot study conducted in parallel controlled groups. Mirror therapy and strength training were two arms of treatment. Adverse effects, compliance and suitability were also evaluated. Mirror therapy could not play an important role while practicing isometrically, it was significantly better when applied in alternating training as was concluded in a study by Colomer et al, 2016.[20] The present study was carried out on a limited sample size due to a limited number of patients in a particular stage of the disease. Further studies should be conducted on a larger sample size. Mirror therapy should be part of rehabilitation in physiotherapy management as it has an important positive role in improving motor function and strength in the upper extremity in stroke patients. Proper awareness about the Mirror therapy technique should be given to all physical therapists so that they can work more on it and find its further effects.

CONCLUSION

Mirror therapy has an important role in enhancing motor function and strength in the upper extremity, especially as an adjunct treatment to conventional therapy in patients with sub-acute stroke.

DECLARATIONS

CONSENT TO PARTICIPATE: Written consent had been taken from patients. All methods were

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performed following the relevant guidelines and regulations.

Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.

Competing interests: None

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CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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