

RESEARCH ARTICLE

EFFECT OF MIRROR THERAPY VERSUS REPETITIVE FACILITATION EXERCISE ON UPPER LIMB FUNCTION IN POST STROKE PATIENT

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ABSTRACT

Background: After stroke one of the most devastating consequences is the hemiparetic arm. Difficulty in using this UL in daily tasks has been related to lower quality of life, improving use of the affected UL is important. **Objective:** To compare the effects of task-based mirror therapy and Repetitive Facilitation Exercise on upper limb function in post stroke patient. **Methodology:** A randomized controlled trial was conducted in Pakistan Railway general hospital, Rawalpindi. The duration of this study was from 10th July to 31st December 2019. Non-probability purposive sampling technique was used with n=50 male and female subacute and chronic post-stroke patients between 40-50 years. The patients with Modified Ashworth Scale <3 and the first-ever stroke was included. The participants were randomly divided by the sealed envelope method into mirror therapy group (n=25) and Repetitive Facilitation Exercise group (n=25). The Upper extremity functional index (UEFI) was used to assess the functional impairment in individuals with upper limb dysfunction, Fugl Meyer (FMA-UE) for assessment of activity in post stroke patients, "Wolf Motor Function Test (WMFT) for upper extremity performance and functional capability" and Brunnstrom recovery scale (BRS) for motor function of the upper limb was used in a post stroke patient. All the patients were assessed at baseline than after 3 weeks and again after 6week for interventional session of 30 min,3 days of the week. Data were analyzed through SPSS version 23. **Results:** The mean age of Group A (MT) was 50.97±6.741 and 49.76±12.66 of Group B (RFE). After 6 weeks of intervention between groups analysis of Task-based mirror therapy showed significant improvement in mirror therapy group as compare to Repetitive Facilitation Exercise group, for upper extremity functional index scores(p<0.001) but for motor assessment (FMA-UE), Wolf Motor Function Test (WMFT) and for stroke recovery (Brunnstrom) no statistically significant difference (p≥0.05) was found. Within-group analysis of both groups showed statistically significant results in all variables (p<0.001). **Conclusion:** Mirror therapy and Repetitive facilitation Exercise both were found to be effective in improving upper limb motor functions of acute stroke patients. However, Mirror therapy has shown significant effects in upper extremity functional index.

Keywords: Mirror therapy, Physical therapy, Repetitive Facilitation Exercise, Stroke, Upper extremity.

INTRODUCTION

The World Health Organization (WHO) defines stroke as focal or global disturbance of cerebral function with rapidly developing clinical signs having vascular origin¹. Global rate of incidence of stroke is 150.5 per 100,000 in 2017. The prevalence of stroke has increased by 3 percent from 1990 to 2017 which is increased to 1300.6 per 100,000². In Pakistan, the incidence rate is 250 per 100,000 in comparison with other developed countries³. The incidence rate was 584,000 out of 650,000 in years 2000 till 2016 and was maximum among people in the 75 to 85 years age group⁴.

A wide diversity of clinical signs and symptoms are exhibited with Stroke impairments. A common and unfortunate sequel of stroke is activity limitation due to the paretic upper⁵. The upper limb (UL) stroke impairments are as high as 80%. After stroke one of the most devastating consequences is the hemiparetic arm. Difficulty in using this UL in daily

tasks has been related to lower quality of life, improving use of the affected UL is important⁶. A popular and new therapeutic intervention used these days is mirror therapy (MT) which is pain less, affordable, and moreover patient-directed care which targets the movement of the unimpaired limb⁶. Ramachandran and Roger Ramachandran discovered this method to enhance treatment procedures for phantom limb pain after surgical removal of a limb, also known as amputation⁷. Theory of MT is that it uses a mirror to generate visual feedback for the patient which creates an illusion and tricks the brain into believing that the motion was painless⁸. A mirror is placed between both limbs and the patient is instructed to perform a task with the unaffected hand, followed by moving the affected arm at the same time and the same way all the while looking in the mirror⁹. Another recently discovered technique known as Repetitive facilitative exercise (RFE) is popular in

the rehabilitation of limb impairment because of stroke. It combines high rate of repetition and neuromuscular facilitation¹⁰. RFE uses skin-muscle or a stretch reflex such that isolated muscle movements are encouraged. It provides a physical stimulation either when the patient attempts to move the hemiplegic part, or just before the movement¹¹. Number of repetitions of the movements using RFEs are proportional to the rate of clinical improvement or the functional status of the patient's hemiplegic upper limb and hand, mainly when they are altered by a synergic pattern¹².

Impairments of upper extremity functional are common in stroke. Therefore, continuous investigation of effective interventions for upper extremity functions after stroke is necessary. This study aims to determine which protocol is best for upper limb function improvement so that protocol could be followed and the function of the upper limb of post-stroke patients can be maximised and the quality of life of stroke can be improved.

METHODOLOGY

A randomized controlled study (NCT04468945) was conducted from 10th July to 31st December 2020 at

Pakistan Railway general hospital Rawalpindi after approval from ethical view committee and clinical trial registry. The sample size was n=50 patients (25 in each group) Calculated through open epi tool¹³. The participants were selected by non-probability purposive sampling technique. A written informed consent was taken from each patient. The assessor-blinded technique was used for randomization by the sealed envelope method The Inclusion criteria were male and female hemiparetic patients suffering from first attack of stroke having good sitting balance, with the age between 40-60 years, also having scores over 24 on Mini Mental State Examination and less than 3 score on Modified Ashworth scale. The exclusion criteria were unstable, uncooperative patient, orthopedic deformity, Aphasia, visual defect, Joint pain (shoulder, elbow, wrist, hip, knee, ankle) having any co-morbidities and other medical complications. The n=25 participants were recruited in the Mirror Therapy group and n=25 was in the Repetitive Facilitation Exercise group. Out of which n=4 participants were dropped out from the Mirror Therapy (n=21) and 5 from the Repetitive Facilitation Exercise (n=20) group. (Figure 1).

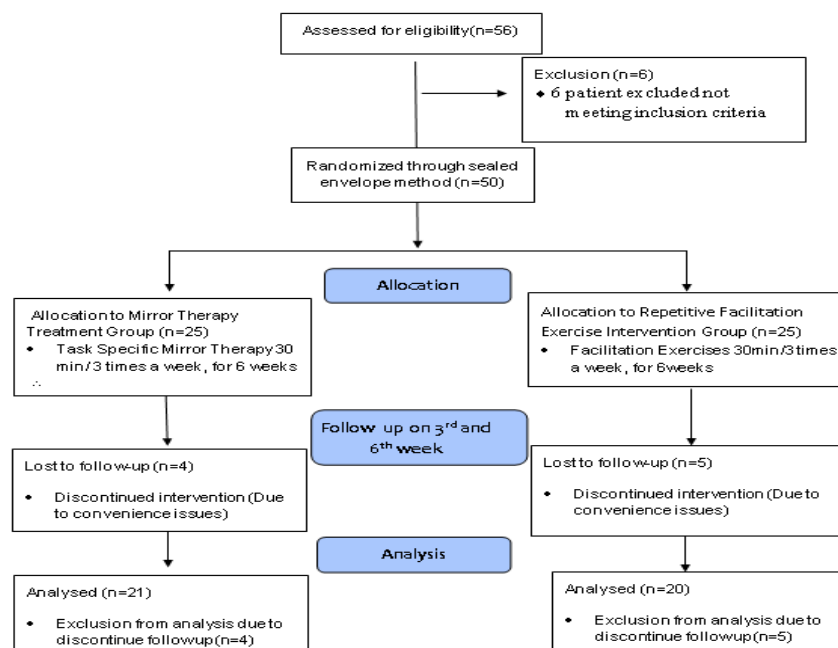


Figure 1: CONSORT diagram

The assessment was done through Fugal-Meyer assessment tool for the assessment of upper extremity motor activity and total upper limb score is 66. The Wolf Motor Function for upper extremity

performance and functional capability in post stroke patient. The movement quality during the task is measured by functional ability using a 6-point ordinal scale, where 0=does not attempt with

the involved arm and 5=arm does participate/movement appears to be normal. The Upper extremity functional was also used to assess the functional impairment in upper limb dysfunction. It consists of 20-item questionnaire and each item scored on 5-point ordinal scale. The total sum of all items score is 80 points. The Brunnstrom recovery scale is used to evaluate the motor recovery in stroke patient It consist of 7-stages 1st one represents the flaccid paralysis, and 7th shows normal.

The Group A received mirror therapy (MT) using Task specific mirror box therapy for 30 min per day thrice a week for consecutive 6 weeks. The patients were seated close to table and a mirror is vertically placed. The affected hand was placed behind the mirror while normal hand in front of the mirror. For the task specific mirror therapy the duster, glass, wooden block of different sizes and shapes, beads, coin, paper cards and spongy ball were used. In all these activities the movements performed at shoulder level are horizontal flexion-extension and adduction-abduction, at elbow flexion-extension, at forearm supination-pronation, at wrist flexion-extension and finger flexion, extension, abduction, adduction & opposition were performed cooperatively. The patients were asked to transfer a small cube from the middle position to the lateral side, placing pegs in holes and taking them out, turning over paper cards, placing steel needles in holes, stacking blocks, and putting glass on a shelf. During the sessions subjects was asked to do these activities by non-paretic limb and asked to do same movement simultaneously with the paretic hand.

The Group B received Repetitive Facilitation Exercises (RFE) for 30 minutes. a day, 2 set of 50 repetitions with 1 -2 minutes rest time for 3 times a week for consecutive 6 weeks. The repetitive facilitative techniques were designed to minimize the synergy patterned movements of the shoulder, elbow, wrist, and fingers. This Treatment protocol used rapid passive stretching of the targeted joints muscles combined with tapping and rubbing the skin to assist the contraction of muscle. The activities performed are Shoulder horizontal flexion & extension, adduction-abduction, elbow flexion-extension, forearm supination-pronation, wrist flexion-extension, finger flexion-extension, abduction, adduction, and opposition. Participants

were asked to concentrate on generating movement on that joint being treated while avoiding non-targeted muscles contractions. The verbal directions & commands such as bend/straighten or one, two & three were provided by therapist. Participant efforts were required to achieve a full range of motion (ROM).

After completing the assessments on 3rd and 6th week the data was analyzed by using the SPSS version 21. The demographic data was presented as mean±Sd and categorical variable as frequency and percentages. As the assumptions of parametric test were not met, for between group analysis Mann Whitney U was performed and Friedmann test with pairwise comparison for week wise analysis was used. The level of significance was set at $p < 0.05$ and SPSS version 21 was used for data analysis

RESULTS

The mean age of Group A (MT) was 50.97 ± 6.741 and 49.76 ± 12.66 of Group B (RFE). The percentages of male patients were 20(81%) in Group A and 19(76%) were in group B while 5(19%) females were in group A and 6(23%) in group B with right hemiplegia 10(42%) in group A and 14(52%) in group B while 15(57%) in Group A and 11(47%) in group B were left hemiplegic patients.

When comparing the groups, the upper extremity functional index (UEFI) shows significant result in both groups as $p < 0.05$ which is ($p = 0.07$) at baseline, at 3rd week ($p = 0.006$) and at 6th week ($p = 0.005$) while between group analysis Fugyl-Meyer Total A-D, Wolf motor scale (gross), Wolf motor scale (fine), Wolf and Brunnstrom recovery scale shows non-significant results as $p > 0.05$. (Table 1)

Friedman Test was applied for week wise analysis within both groups which shows median (IQR) of upper extremity functional index (UEFI), FMA-UE, WMS (gross), WMS (fine) and Brunnstrom recovery scale in group A ($p < 0.001$) and in group B the ($p < 0.001$) as p-value of both groups were $p < 0.05$ which shows significant improvement from baseline to 6th week within both groups. (Table 2) The within group analysis of both groups was performed by Wilcoxon Signed Rank Test in upper extremity functional index (UEFI), FMA-UE, WMS (gross), WMS (fine) and Brunnstrom recovery scale shows significant results as ($p < 0.05$). (Table 2)

Table-1: Comparison Group A and Group B. (UESFI, FM, WM-G, WM-F & BRC.)

Variables	Assessment	Group A	Group B	p-value
		(n=21)	(n=20)	
Upper Extremity Functional Index	Baseline	12(6)	10(2)	0.07
	3 rd week	26(6)	21(5)	0.006
	6 th week	35(6)	28(6)	0.005
Fugl Meyer Total	Baseline	14(6)	12(3.5)	0.5
	3 rd week	24(3)	24(8)	0.5
	6 th week	35(7)	34(5)	0.6
Wolf Motor (Gross)	Baseline	14(2)	14(6)	0.2
	3 rd week	21(3)	21(6)	0.07
	6 th week	28(4)	24(5.5)	0.08
Wolf Motor (Fine)	Baseline	10(2.5)	11(4)	0.2
	3 rd week	15(7)	16(4)	0.1
	6 th week	19(5.5)	19(3)	0.3
Brunnstrom Recovery Scale	Baseline	5(1)	4(1)	0.3
	3 rd week	6(1)	6(1)	0.4
	6 th week	6(0)	6(0)	0.4

Significance level: $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$

Table 2: With-in group changes from baseline to 6th week in both groups

Variables	Assessment	Group A (n=21)			Group B (n=21)		
		Median (IQR)	Mean Rank	p-value	Median (IQR)	Mean Rank	p-value
Upper Extremity Functional Index	Baseline	12(6)	1.1	^a 0.001***	10(2)	1.1	^a 0.001***
	3 rd week	26(6)	1.1	^b 0.001***	21(5.5)	1.1	^b 0.001***
	6 th week	35(6)	1.1	^c 0.001***	32(6)	1.1	^c 0.001***
Fugl Meyer Total	Baseline	14(6)	1.1	^a 0.001***	12(3)	1.1	^a 0.001***
	3 rd week	24(3.5)	1.1	^b 0.001***	24(3)	1.1	^b 0.001***
	6 th week	35(7)	1.1	^c 0.001***	34(5)	1.1	^c 0.001***
Wolf Motor(G)	Baseline	14(2)	10.0	^a 0.001***	14(6)	11.5	^a 0.001***
	3 rd week	21(3)	10.5	^b 0.001***	21(6)	8.5	^b 0.001***
	6 th week	28(4)	11.0	^c 0.001***	24(5)	11.5	^c 0.001***
Wolf Motor (F)	Baseline	10(2.5)	11.0	^a 0.001***	11(4)	11.0	^a 0.001***
	3 rd week	15(7)	10.4	^b 0.001***	16(4)	10.4	^b 0.001***
	6 th week	19(5)	11.0	^c 0.001***	19(3)	11.4	^c 0.001***
Brunnstrom Recovery Scale	Baseline	5(1)	10.0	^a 0.001***	4(1)	9.6	^a 0.001***
	3 rd week	6(1)	5.0	^b 0.003**	6(1)	5.0	^b 0.004**
	6 th week	6(0)	10.0	^c 0.001***	6(0)	9.5	^c 0.001***

^abaseline to 3rd week, ^b3rd week to 6th week & ^cbaseline to 6th week.
Significance level: $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$

DISCUSSION

The results of current study suggested that in terms of improving hemiplegic upper limb motor impairment, both treatments were effective equally with Mirror Therapy (MT) seemed to have beneficial effects over RFE as indicated by Upper extremity functional index. The results of this study showing significance of both treatment options is in accordance with a previous study, the current study has the strength of a larger sample size with a 2-week longer study duration⁷.

The mechanism of mirror therapy is to create normal movement mirror illusion of the affected hand, helping the premotor cortex by increasing the proprioceptive information, and intimate connection between visual input and premotor areas⁷. Improved recovery was observed in MT, it affects the motivation of the patient which will

eventually increase concentration and participation activities in the program¹⁴. Present literature reported mirror therapy has significant potential to improve upper limb function and daily living activities¹⁵. Another study presented that mirror therapy with the functional task is effective on the upper limb which showed similar findings that upper limb function significantly improved in task-based mirror therapy group with $p < 0.001$ measured by Fugl-meyer assessment of upper limb¹⁶. Upper limb impairment in the range, speed, and accuracy has been improved through mirror therapy in chronic stroke patients²³. However a study reported that the effect is due to the action of mirror illusion of a visual image is still not clear, however it can be added along with task-specific exercises as it will improve the recovery¹⁷.

Another study stated that they did not observe mirror-related activity in motor or mirror neuron system areas but showed increased activity in the precuneus and posterior cingulate cortex, areas associated with awareness of the self and spatial attention during bimanual movement. It was reported by increasing awareness of the affected limb, the mirror illusion might reduce learnt non-use¹⁸. A systematic review advocating mirror therapy (MT) stated that it was better than sham therapy, mainly in the subacute phase as the therapy uses the mirror to make illusions about movement occurring in a painless way thus enhancing the motor ability, but the meta-analyses were nonsignificant²².

The effect of RFE was developed on the isolation from synergy and the manipulation of objects of the hemiplegic upper limb was assessed and seen for 6 weeks. Depicting significant results in within-group analysis in Upper extremity functional index (UEFI), Fugl Meyer assessment of upper extremity (FMA-UE), Wolf Motor Function Test (WMFT) and Brunnstrom recovery scale (BRS). A previous study indicated the positive effect of repetitive facilitative over the conventional neuro facilitation therapy, to improve the lower-limb motor function after 4 week of exercise sessions¹⁹. Another study compared the efficacy of repetitive facilitation exercise on the upper limb in a subacute stroke patient, which shows significant improvement in repetitive facilitation exercise group measured by action research arm test and by Fugl meyer assessment of upper extremity with $p < 0.01$. 9) Same results were achieved through REF in another study whereas they focused on repetitive grasping and gripping activity that provides physical stimulus used by RFE is proportional to the rate of improvements in functional movements of upper limb. The MT and RFE has proven to be better than standard rehabilitation therapy as combine repetitive facilitation exercises and visual illusion using mirror therapy helps in improving functions by integration of movements. These can be integrated into stroke rehabilitation therapy to improve upper extremity function²⁰.

Limitation of study was the study duration which is 3 days a week for 6-week longer time duration is recommended to record long term benefits with larger sample size.

CONCLUSION

Mirror therapy and Repetitive facilitation Exercise both were found to be effective in improving upper limb motor functions of acute stroke patients, However, Mirror therapy has shown significant effects in upper extremity functional index.

The future studies with right and left hemiplegia, gender-based differences, sub-acute and chronic stroke studies are also recommended. The study can also be done to improve lower extremity function. With longer duration of study and various outcome measure can be used to record that functional independence in a better way.

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