

## Original Research Article

# Effectiveness of mirror therapy through functional activities and motor standards in the motor recovery in post stroke hemiplegic patients: a prospective randomized controlled trial in a tertiary care hospital in Northeast India

Ningthemba Yumnam<sup>1</sup>, Joy Singh Akoijam<sup>1\*</sup>, Joymati Oinam<sup>2</sup>

<sup>1</sup>Department of Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences, Imphal, Manipur, India

<sup>2</sup>Department of Community Medicine, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India

**Received:** 14 March 2019

**Revised:** 08 April 2019

**Accepted:** 12 April 2019

### \*Correspondence:

Dr. Joy Singh Akoijam,

E-mail: joyakoijam2@yahoo.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** Upper limbs are very important to motor functionality. However, in majority of stroke patients, arm functions are impaired resulting in disabilities and restrictions to function. Therefore, the objective of this study was to assess the effectiveness of mirror therapy in the motor recovery of upper extremity in the post stroke hemiplegic patient.

**Methods:** A prospective randomized controlled trial was conducted among 72 post stroke patients aged 35-65 years having hemiparesis attending the PMR OPD in RIMS, Manipur from 2013 to 2016. Assessment was done for FIM self care and Brunnstrom stages of motor recovery at baseline and 1 month and 6 month of post treatment. Both the study and control group participated in a stroke rehabilitation programme and study group was given mirror therapy in addition. Descriptive statistics such as mean, standard deviation and inferential statistics like Chi-square test, Student's t test, and ANOVA were used. A p-value <0.05 was taken as statistically significant.

**Results:** Mean age were 54.56±7.61 years (study) and 55.11±7.99 years (control). Majority of them were males (61.1%). Significant improvement was noted in the study group from baseline to 1 month and 6 months follow up. Mean score comparison of FIM self care between study and control group from baseline to 1 month was (28.28±3.11 to 34.11±2.59 vs 28.00±4.30 to 29.50±4.58) and from 1 to 6 months follow up was (34.11±2.59 to 37.83±2.04 vs 29.50±4.58 to 32.44±4.82) respectively.

**Conclusions:** There was a significant improvement in hand function regarding both motor recovery and daily self care activities in the study group.

**Keywords:** Brunnstrom stages, FIM, Mirror therapy, Stroke, Upper extremity

## INTRODUCTION

Upper limbs are very important to motor functionality and the effective handling, gripping and reaching capability required in most ADLs. Arm functions are impaired in 73-88% of CVA survivors, and 55-75% of

them present hemiplegia, resulting in disabilities and restrictions to function.<sup>1-3</sup>

Currently among therapies available for the upper limbs post stroke rehabilitation, mirror therapy is one of them which have been seen to provide encouraging results in

treatment of hemiparesis. Mirror therapy (MT) is a low-cost and easy intervention developed by Ramachandran and colleagues for the treatment of phantom limb pain that is currently used in post-stroke rehabilitation.<sup>3-6</sup> It has been reported that mirror therapy improved range of motion, speed and dexterity of the affected arm.<sup>3</sup>

This therapy tricks the brain by promoting a visual and kinesthetic illusion, when the subject performs movements with the normal limb that are reflected to the mirror and interpreted by the brain as performed by the affected limb.<sup>7-8</sup> MT is a strategy proven feasible and effective for motor recovery.<sup>1,2,8-11</sup> The effects of this therapy are beneficial for movement execution and control, but do not reflect in CVA patients' daily activities.<sup>12</sup>

Still there is lacks studies about mirror therapy approaches which aimed at movements related to functional activities or to the motor patterns of post stroke hemiplegic arm. Therefore, the objective of this study was to assess the effectiveness of mirror therapy of the upper limb muscles using functional activities and motor patterns in post stroke hemiplegic patients.

## METHODS

This was a prospective randomized controlled trial was conducted in the Department of Physical Medicine and Rehabilitation (PMR), Regional Institute of Medical Sciences (RIMS), Manipur, a tertiary care hospital in Northeast India from October 2013 to September 2016. All post stroke patients aged 35-65 years with hemiparesis attending the PMR OPD were examined and screened according to the eligibility criteria. Inclusion criteria includes patients having first episode of unilateral stroke within 3-6 months, Brunnstrom motor recovery stages II-IV in the affected upper extremity, able to understand and follow simple verbal instruction, spasticity of upper extremity not more than grade II, intact proprioception were included. Those who have cognitive impairment, vision problem, flaccid paralysis and not willing to participate were excluded. A sample size of 72 patients (36 in each group) were calculated using formulae;

$$n = (z\alpha + z\beta)^2 (S_1^2 + S_2^2) / (m_1 - m_2)^2$$

Where, s= standard deviation, m= mean,  $z\alpha=1.96$  at 95% CI,  $z\beta=0.842$ , 80% power and taking into consideration a drop-out rate of 10%.

### Methods of recruitment

Seventy-two patients with upper limb hemiplegia were enrolled in this study and were randomly assigned into two groups. Thirty-six patients were assigned to the study group and 36 patients to the control group by using a block randomization technique. A block size of four was used. Possible treatment allocation within each block

was: (i) AABB (ii) BBAA (iii) ABAB (iv) BABA (v) ABBA (vi) BAAB. Using random number table, a list of blocks was prepared. Since a sample of 72 patients needs to be enrolled; a list of 18 blocks was prepared.

### Outcome measures

All patients went through a comprehensive clinical evaluation at baseline and 1 month and 6 months after the treatment. Clinical evaluations were always performed by the same investigator. Outcome measures includes: Functional Independence Measures (FIM) and Brunnstrom stages of motor recovery. The FIM instrument is a basic indicator of severity of disability which comprises of 18 items, and total scores ranges from 18 to 126. The items are divided into motor items and cognitive items. The scale provides for the classification of individuals by their ability to carry out an activity independently, versus their need for assistance from another person or a device. Brunnstrom stages of motor recovery helps to assess the degree of motor recovery. It has got six stages ranging from complete flaccid to near normal voluntary movement.

### Procedures

A baseline initial functional assessment was done by using the FIM instrument and Brunnstrom stages of motor recovery. A follow up assessment was done at 1 month and 6 month of treatment.

### Interventions

*Conventional stroke rehabilitation programme (both study and control group)*

Both the study and control group were participated in a conventional stroke rehabilitation programme in the department of PMR for 3 days a week for 30 minutes in a day for 1 month. This programme was patient-specific and consisted of neuro-developmental facilitation techniques, stretching and strengthening exercises, ADL training in occupational therapy and speech therapy (if needed).

### *Mirror therapy (only study group)*

The study group was given mirror therapy for 30minutes in addition to the conventional stroke rehabilitation programme. During the mirror therapy, patients were seated close to a table on which a mirror (30.5× 30.5cm) was placed vertically. Non-paretic hand was placed in front of the mirror and made to do elbow, forearm, wrist and finger movements, while the patient looks into the mirror.

Ethical approval was obtained from the Research Ethics Board of RIMS, Imphal. Written informed consent was obtained from the patient before the start of the study.

### Statistical analysis

Data collected were entered and analyzed using SPSS IBM Statistics version 21 (Chicago, IL, USA). Descriptive statistics such as mean, SD, percentages were used. Inferential statistics such as Chi-square test, Student's t test, and Repeated measures ANOVA were used. A probability value <0.05 was considered as statistically significant.

### RESULTS

Seventy two patients were randomly allocated into either study or control group having 36 patients in each group. Mean age of the participants were  $54.56 \pm 7.61$  years (study) and  $55.11 \pm 7.99$  years (control).

**Table 1: Table showing background characteristics of the study and control group (n=72).**

Parameters	Group n (%)		P-value*
	Study	Control	
<b>Age (years) mean (SD)</b>	54.56(7.61)	55.11(7.99)	
35-45	8(50.0)	8(50.0)	0.69
46-55	8(42.1)	11(57.9)	
56-65	20(54.1)	17(45.9)	
<b>Gender</b>			
Male	20(45.5)	24(54.5)	0.33
Female	16(57.1)	12(42.9)	
<b>Onset</b>			
Insidious	14(58.3)	10(41.7)	0.32
Sudden	22(45.8)	26(54.2)	
<b>Side of weakness</b>			
Left	24(52.2)	22(47.8)	0.62
Right	12(46.2)	14(53.8)	
<b>Duration of stroke</b>			
≤4weeks	22(52.4)	20(47.6)	0.83
≤24weeks	8(50.0)	8(50.0)	
>24weeks	6(42.9)	8(57.1)	
<b>Cranial nerve involvement</b>			
Facial	8(53.3)	7(46.7)	0.28
Hypoglossal	4(66.7)	2(33.3)	
Both	18(46.2)	21(53.8)	
None	6(50)	6(50)	
<b>Speech</b>			
Aphonia	2(100)	0	0.36
Slurring of speech	28(48.3)	30(51.7)	
Not affected	6(50.0)	6(50.0)	
<b>Proprioception</b>			
Intact	26(48.1)	28(51.9)	0.58
Impaired	10(55.6)	8(44.4)	
<b>Risk factors</b>			
Hypertension	10(27.8)	18(72.2)	0.08
CAD	10(27.8)	4(11.1)	
Smoking+Alcohol+Hypertension	16(44.4)	14(38.9)	
<b>Stroke type</b>			
Infarct	26(59.1)	18(40.9)	0.05
Hemorrhagic	10(35.7)	18(64.3)	

\*Chi-square test

**Table 2: Table showing the functional self care score and motor recovery of study participants at baseline (N=72).**

Group	No. of cases	Parameters mean (SD)	P-value*
FIM Self care score			
Study	36	28.28(3.11)	0.75
Control	36	28.0(4.30)	
Brunnstrom's stages of motor recovery			
Study	36	2.0(0.34)	0.42
Control	36	1.94(0.23)	

\*Student's t test

A summary of the demographic and clinical features of the patients in between the study and control group is shown in Table 1 and Table 2.

When comparison was done between the two groups at baseline no statistically significant differences were noted. Among the study group, majority were in the age range of 56-65 years (20, 54.1%) followed by 35-45 years (8, 50%). More than half of the participants in the study group were female (16, 57.1%), had infarct type of stroke (26, 59.1%) which was insidious in onset (14, 58.3%), duration of stroke ≤4 weeks (22, 52.4%), left sided weakness (24, 52.2%), impaired proprioception (10, 55.6%) and hypoglossal nerve involvement (4, 66.7%). Regarding the control group, majority were in the age range of 46-55 years (11, 57.9%) years. More than half of the participants were male (24, 54.5%), had hemorrhagic stroke (18, 64.3%) which was sudden in onset (26, 54.2%), duration of stroke >24 weeks (8, 57.1%), right sided weakness (14, 53.8%), intact proprioception (28, 51.9%) and both facial and hypoglossal nerve involvement (21, 53.8%) (Table 1).

At baseline, the mean change scores of the FIM Self care score was comparable between the study and control group (mean change,  $28.28 \pm 3.11$  vs  $28.0 \pm 4.30$ ; P-value 0.75) respectively. Similarly, the mean change scores of the Brunnstrom's stages of motor recovery was  $2.0 \pm 0.34$  in the study group vs  $1.94 \pm 0.23$  in the control group; P-value 0.42. When comparison was done between the study and control groups at baseline regarding the functional self care score and motor recovery, no statistically significant differences were noted (Table 2).

This table 3 shows there was significant improvement of functional self cares recovery in both groups separately ( $p < 0.05$ ). When inter-group comparison was done between study and control groups, significant improvement was noticed in the study group from baseline to 1 month and from 1 to 6 months follow up. Mean score comparison of functional self care from baseline to 1 month was ( $28.28 \pm 3.11$  to  $34.11 \pm 2.59$  vs  $28.00 \pm 4.30$  to  $29.50 \pm 4.58$ ) and from 1 to 6 months follow up was ( $34.11 \pm 2.59$  to  $37.83 \pm 2.04$  vs  $29.50 \pm 4.58$  to  $32.44 \pm 4.82$ ).

**Table 3: Table showing the functional self care score and motor recovery of study participants at baseline, 1 month and 6 months follow up (N=72).**

Parameters	Groups Mean (SD)		p-value*
	Study (n=36)	Control (n=36)	
<b>FIM Self care</b>			
Baseline	28.28(3.11)	28.00(4.30)	<0.001
1 month	34.11(2.59)	29.50(4.58)	
6months	37.83(2.04)	32.44(4.82)	
<b>Brunstrom stages motor recovery</b>			
Baseline	2(0.34)	1.94(0.23)	0.02
1 month	3.17(0.38)	2.83(0.38)	
6 months	4.22(0.42)	3.17(0.38)	

\*Repeated measures ANOVA

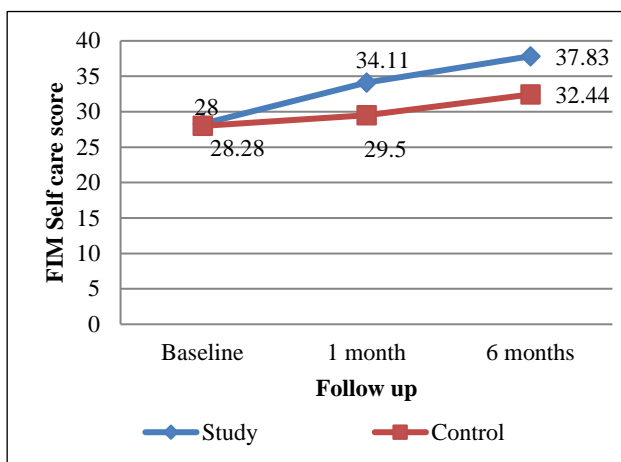
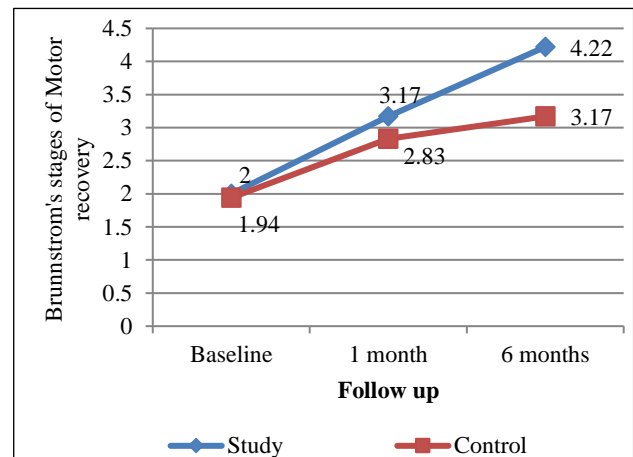
**Figure 1: The trend of improvement of FIM self care score between the groups.**

Figure 1 shows that among the control group, the mean FIM self care score was 28.28 at baseline followed by 29.5 and 32.44 at 1 and 6 months follow up respectively. However, in the study group, the mean FIM self care score was 28 at baseline followed by 34.11 and 37.83 at 1 and 6 months follow up respectively, which shows that in both the group improvement in the FIM self care is there, however the trend of improvement in the FIM self care score from baseline to 1 month and 6 months follow up was more among the study group compared to control group as shown in the figure above.

Figure 2 shows that among the control group, the mean Brunnstrom's stages of motor recovery was 1.94 at baseline followed by 2.83 and 3.17 at 1 and 6 months follow up respectively. However, in the study group, the mean Brunnstrom's stages of Motor recovery was 2 at baseline followed by 3.17 and 4.22 at 1 and 6 months follow up respectively, which shows that in both the group, improvement in the Brunnstrom's stages of motor recovery is there, however the trend of improvement in the subsequent follow up was more among the study

group compared to control group as shown in the figure above.

**Figure 2: Trend of improvement of Brunnstrom's stages of motor recovery between the groups.**

## DISCUSSION

Literature review shows higher incidence of stroke in male worldwide varying from 0.95-2.13. In the present study males accounted for 61.1% and females 38.9% with a ratio of 1.5:1. Similar finding of 1.2:1 was noted in a study conducted by Dhamija et al in 2008.<sup>13</sup>

In this randomized control trial, it was found that there was significant improvement of functional self cares and motor recovery in both groups separately ( $p < 0.05$ ). When comparison was done between the groups, significant improvement was noticed in the study group from control group at baseline to 1 month and from 1 to 6 months follow up. Mean score comparison of functional self care from baseline to 1 month was  $(28.28 \pm 3.11$  to  $34.11 \pm 2.59$  vs  $28.00 \pm 4.30$  to  $29.50 \pm 4.58$ ) and from 1 to 6 months follow up was  $(34.11 \pm 2.59$  to  $37.83 \pm 2.04$  vs  $29.50 \pm 4.58$  to  $32.44 \pm 4.82$ ). There was significant improvement in motor recovery from baseline to 1 month and 1 to 6 months follow up.

In a study conducted by Yavuzer G et al, have shown similar findings, in their study they had motor recovery, and hand-related functioning scores of patients at baseline, post treatment, and follow-up.<sup>8</sup> The mean change scores and 95% confidence intervals (CIs) of the Brunnstrom stages for the hand (mean change, 1.5; 95% CI, 1.1-1.9 vs mean change, 0.4; 95% CI, 0.1-0.8;  $P < .001$ ) and upper extremity (mean change, 1.6; 95% CI, 1.3-1.9 vs mean change, 0.3; 95% CI, 0.1-0.6;  $P < .001$ ) and the FIM self-care score (mean change, 8.3; 95% CI, 6.5-10.1 vs mean change, 1.8; 95% CI, 0.3-3.2;  $P < .001$ ) improvement at follow-up in the mirror group compared with the control group. In a study by Tufail M et al, reported that after one month of mirror therapy and exercise programme, mean of study group increased to  $3.30 \pm 1.088$  while that of control group increased to

3.23±0.679.<sup>14</sup> Similarly, a study by Thieme H et al conducted among visuospatial neglect patients after stroke and found that mirror therapy had a significant effect on motor function (post-intervention data: SMD 0.61; 95% confidence interval (CI) 0.22 to 1.0; P = 0.002; change scores: SMD 1.04; 95% CI 0.57 to 1.51; P<0.0001) and improve activities of daily living (SMD 0.33; 95% CI 0.05 to 0.60; P = 0.02).<sup>15</sup>

Similar findings were reported in other studies<sup>16-18</sup> where they found that after one month of treatment patients of both groups showed statistically significant improvements in all the variables measured (P<0.05). Moreover, patients of the mirror therapy group had greater improvements in FIM values compared to conventional therapy group (P<0.05).

## CONCLUSION

There was a significant hand function improvement in the study group regarding both motor recovery and daily self care activities when mirror therapy was given in addition to a conventional stroke rehabilitation programme. From the above findings, it can be considered that mirror therapy is a promising method to improve functional activities of daily living and motor recovery of the upper limb in post stroke patients.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. Michielsen ME, Selles RW, Geest JNV, Eckhardt M, Yavuzer G, Stam HJ, et al. Motor recovery and cortical reorganization after mirror therapy in chronic stroke patients: A phase II randomized controlled trial. *Neurorehabilitation Neural Repair.* 2011;24(3):223-33.
2. Thieme H, Bayn M, Wurg M, Zange C, Pohl M, Behrens J. Mirror therapy for patients with severe arm paresis after stroke-A randomized controlled trial. *Clin Rehabil.* 2012;27(4):314-24.
3. Wu CY, Huang PC, Chen YT, Lin KC, Yang HW. Effects of mirror therapy on motor and sensory recovery in chronic stroke: A randomized controlled trial. *Arch Phys Med Rehabil.* 2013;94:1023-30.
4. Thieme H, Mehrholz J, Pohl M, Behrens J, Dohle C. Mirror therapy for improving motor function after stroke. *Stroke.* 2013;44:1-2.
5. Ramachandran VS, Rogers-Ramachandran D, Stewart M. Perceptual correlates of massive cortical reorganization. *Science.* 1992;258:1159-60.
6. Machado S, Velasques B, Paes F, Cunha M, Basile LF, Budde H, et al. Terapia-espelho aplicada à recuperação funcional de paciente pós-acidente vascular cerebral. *Rev Neurocienc.* 2011;19(1):171-5.
7. Altschuler EL, Wisdom SB, Stone L, Foster C, Galasko D, Llewellyn DME, et al. Rehabilitation of hemiparesis after stroke with a mirror. *Lancet.* 1999;353:2035-6.
8. Yavuzer G, Selles R, Sezer N, Sutbeyaz S, Bussmann JB, Koseoglu F, et al. Mirror therapy improves hand functions in subacute stroke: A randomized controlled trial. *Arch Phys Med Rehabil.* 2009;89:393-8.
9. Ramachandran VS, Altschuler EL. The use of visual feedback, in particular mirror visual feedback, in restoring brain function. *Brain.* 2009;132:1693-710.
10. Yun GJ, Chun MH, Park JY, Kim BR. The synergic effects of mirror therapy and neuromuscular electrical stimulation for hand function in stroke patients. *Ann Rehabil Med.* 2011;53:316-21.
11. Kang YJ, Ku J, Kim HJ, Park HK. Facilitation of corticospinal excitability according to motor imagery and mirror therapy in healthy subjects and stroke patients. *Ann Rehabil Med.* 2011;35:747-58.
12. Wu CY, Huang PC, Chen YT, Lin KC, Yang HW. Effects of mirror therapy on motor and sensory recovery in chronic stroke: A randomized controlled trial. *Arch Phys Med Rehabil.* 2013;94:1023-30.
13. Dhamija RK, Sarika A, Gaba P, Jais M, Kaintura A, Kumar M, et al. Study of genetic, metabolic and inflammatory risk factors in patients of acute ischemic stroke. *Indian J Clin Biochem.* 2008;23(2):136-43.
14. Tufail M, Wadhwa RK, Borah DB, Nonica L, Kothari SY. Evaluation of mirror therapy for upper limb rehabilitation in stroke. *IJPMR.* 2013;24(3):63-9.
15. Thieme H, Mehrholz J, Pohl M, Behrens J, Dohle C. Mirror therapy for improving motor function after stroke. *Cochrane Database Syst Rev.* 2012;3:CD008449.
16. Zacharis D, Moutzi E, Terzis N, Roussos N, Patatoukas D. The use of mirror therapy in stroke patients with hemiplegic upper limb: a randomized controlled trial. *Ann Phys Rehabil Med.* 2014;57(1):441-6.
17. Invernizzi M, Negrini S, Carda S, Lanzotti L, Cisari C, Baricich A. The value of adding mirror therapy for upper limb motor recovery of subacute stroke patients. *Eur J Phys Rehabil Med.* 2013;49(3):311-7.
18. Bahrami M, Mazloom SR, Hasanzadeh F, Ghandehari K. The effect of mirror therapy on self care of patients with stroke. *J Mazandaran Univ Med Sci.* 2013;23(107):78-88.

**Cite this article as:** Yumnam N, Akoijam JS, Oinam J. Effectiveness of mirror therapy through functional activities and motor standards in the motor recovery in post stroke hemiplegic patients: a prospective randomized controlled trial in a tertiary care hospital in Northeast India. *Int J Res Med Sci* 2019;7:1904-8.