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Original Research Article

Effectiveness of mirror therapy in the motor recovery of upper extremity in the post stroke hemiplegic patients: a randomized controlled trial in a tertiary care hospital in Manipur, Northeast India

Ningthemba Yumnam[1], Joy Singh Akoijam[1]*, Longjam Nilachandra Singh[1], Joymati Oinam[2]

[1]Department of Physical Medicine & Rehabilitation, Regional Institute of Medical Sciences, Imphal, Manipur, India
[2]Department of Community Medicine, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India

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***Correspondence:**
Dr. Joy Singh Akoijam,
E-mail: joyakoijam2@yahoo.com

ABSTRACT

Background: Stroke is a leading cause of disability and majority of the stroke survivors experience upper extremity functional limitations. Therefore, the objective of this study was to evaluate the effectiveness of mirror therapy in addition with a conventional upper limb rehabilitation program in a post stroke hemiplegic patient.
Methods: A randomized controlled trial was conducted among 72 post stroke patients aged 35-65 years having hemipa¬resis attending the PMR department, RIMS, Manipur from 2013 to 2016. Assessment was done at baseline, 1 and 6 months for FIM self care, Brunnstrom stages of motor recovery and MAS for spasticity. Both the group participated in a stroke rehabilitation program and study group was given mirror therapy in addition. Descriptive statistics such as mean±SD 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: There was an improvement in Brunnstrom stage and FIM self-care score in both groups, but the post-treatment score was significantly higher in the mirror therapy group. Statistically significant difference in FIM self care and motor recovery between the study and control groups was noted [1.1±0.38 (study) versus 0.88±0.32 (control) for motor recovery and 34.1±2.59 (study) versus 29.5±4.58 (control) for FIM self care]. However, no significant difference was seen in spasticity between the groups.
Conclusions: Mirror therapy used in addition to conventional stroke rehabilitation program was found to be effective in the recovery of upper extremity motor functions and daily self care activities in post stroke hemiplegic patients.

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

INTRODUCTION

Worldwide, cerebrovascular accidents (stroke) are the second leading cause of death and the third leading cause of disability.[1] Hemiplegia has been reported to develop in 55-75% of stroke survivors and 73-88% experience upper extremity functional limitations.[2-4] Functional loss in the upper extremity causes the patient difficulty in performing daily living activities, and causes to become dependent and decreases their overall quality of life.

The main target in any stroke rehabilitation program is to enable the highest functional independence level possible for the individual so as to increase their quality of life.

Most of the standard multi-disciplinary rehabilitation programmes for stroke patients are challenging, labour-intensive and costly to carry out.[5-7]

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 upper limb hemiparesis. Mirror therapy is a simple low-cost and less labour-intensive rehabilitation method which can also be practiced at home with the help of the family or the caregivers which can ease the burden of the long-term health care expenses, which will help in improving functional disabilities. It was developed by Ramachandran and colleagues for the treatment of phantom limb pain that is currently used in post-stroke rehabilitation.[8-10] There are several studies on the effectiveness of mirror therapy in post-stroke upper extremity rehabilitation. While some studies reported an improvement in the motor functions of patients who underwent mirror therapy and no difference in improvements was reported in some studies.[11-13] Therefore, the objective of this study was to evaluate the effectiveness of mirror therapy together with a conventional upper limb rehabilitation program in a post stroke hemiplegic patient and to determine whether it provides any additional benefit.

METHODS

This was a prospective randomized controlled trial conducted in the Department of Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences, 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 outpatient department were examined and screened according to the inclusion and exclusion criteria. Inclusion criteria includes patients having first episode of unilateral stroke within 3-6 months, Brunnstrom motor recovery between stages II and IV in the affected upper extremity, able to understand and follow simple verbal instruction, spasticity of upper extremity not more than grade II according to the Modified Ashworth Scale, intact propioception were included. Those who have cognitive impairment, vision problem, flaccid paralysis and joint movement limitations in the healthy upper extremity and not willing to participate were excluded from the study.

Sample size

The trial included a sample of 72 patients calculated using the formulae; n=((zα+zβ)^2 (s_1^2+s_2^2))/(m_1-m_(2))^2 . The study had 80% power (zβ=0.842) with 5% type 1 error (zα=1.96) 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 the mirror group (n=36) or the control group (n=36) by using a block randomization technique. A block size of four was used and using random number table, a list of blocks were prepared. Since a sample of 72 patients needs to be enrolled; a list of 18 blocks was prepared. The randomization of the patients was conducted by a physician who was blinded to the study protocol and was not involved in the actual study.

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), Brunnstrom stages of motor recovery and Modified Ashworth Scale (MAS).

The Functional Independence Measure (FIM) self-care subscale evaluates the functional disability level.[14] FIM measures physical and cognitive dysfunction and the need for help and consists of 18 items. The items are divided into two major groups, the Motor items, of which there are 13, and the Cognitive Items, of which there are 5. These items are grouped in 6 subscales measuring self-care, sphincter control, transfers, locomotion, communication, and social cognition. Each item is evaluated with a 7-point Likert scale that specifies the amount of help needed (1=complete dependence, 7=complete independence). The maximum total score is 126 and the maximum self-care score is 42.

Brunnstrom stages of motor recovery helps to assess the degree of motor recovery.[15] It has got six stages ranging from complete flaccid to near normal voluntary movement.

Modified Ashworth Scale is to measure spasticity in patients who have lesions of the CNS or neurological disorders. The MAS is a quick and easy measure. The scale ranges from 0 to 4 through 1+ score.

Procedures

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

Interventions

Conventional Upper Extremity Rehabilitation Programme (Both study and control group)

The patients in both groups underwent 30 minutes of a conventional upper extremity rehabilitation programme 3 times a week for 4 weeks in the department of PMR under the supervision of a physiotherapist. This

programme were organized specifically for each patient 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 30 minutes in addition to the conventional upper extremity 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 & finger movements, while the patient looks into the mirror.

Ethical issues

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

Statistical analysis

Data collected were entered and analyzed using SPSS(v)21 IBM. Descriptive statistics were expressed as mean±standard deviation for numerical variables and as numbers and percentages for categorical variables. Chi square test and Fisher's tests were used to determine differences between the groups regarding frequencies. For the comparisons between the independent groups, the independent samples t-test (Student's t-test) and repeated measures ANOVA were used. The p value less than 0.05 was considered 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±7.61 years (study) and 55.11±7.99 years (control). A summary of the demographic and clinical features of the patients in between the study and control group is shown in Table 1 & 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%), more than half 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 propioception (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 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 propioception (28, 51.9%) and both facial and hypoglossal nerve involvement (21, 53.8%) (Table 1).

Table 1: Background characteristics of the study and control group (N=72).

Parameters	Group n (%)		p-value*
	Study	Control	
Age (years) Mean (SD)	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)	
Gender			
Male	20(45.5)	24(54.5)	0.33
Female	16(57.1)	12(42.9)	
Onset			
Insidious	14(58.3)	10(41.7)	0.32
Sudden	22(45.8)	26(54.2)	
Side of weakness			
Left	24(52.2)	22(47.8)	0.62
Right	12(46.2)	14(53.8)	
Duration of stroke			
≤4weeks	22(52.4)	20(47.6)	0.83
≤24weeks	8(50.0)	8(50.0)	
>24weeks	6(42.9)	8(57.1)	
Cranial nerve involvement			
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)	
Speech			
Aphonia	2(100)	0	0.36
Slurring of speech	28(48.3)	30(51.7)	
Not affected	6(50.0)	6(50.0)	
Propioception			
Intact	26(48.1)	28(51.9)	0.58
Impaired	10(55.6)	8(44.4)	
Risk factors			
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)	
Stroke type			
Infarct	26(59.1)	18(40.9)	0.05
Hemorrhagic	10(35.7)	18(64.3)	

*Chi-square test

At baseline, the mean change scores of the FIM Self care score was comparable between the study and control group (mean change, 28.28±3.11 vs 28.0±4.30; p-value 0.75) respectively. Similarly, the mean change scores of the Brunnstrom's stages of motor recovery was 2.0±0.34 in the study group vs 1.94±0.23 in the control group; P-value 0.42. Similarly for spasticity, the Modified Ashworth score for elbow and wrist at baseline was

comparable between the study and control group (Table 2).

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

Parameter	No. of cases	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)	
Modified ashworth score			
Elbow			
Study	36	1.50(0.85)	0.28
Control	36	1.28(0.88)	
Wrist			
Study	36	1.64(0.68)	0.22
Control	36	1.86(0.83)	

*Student's t test

Table 3: 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)	
FIM Self care			
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)	
Brunstrom stages_Motor recovery			
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)	
Modified Ashworth Score_Elbow			
Baseline	1.5(0.85)	1.28(0.88)	0.23
1 month	1.72(0.57)	1.83(0.78)	
6 months	1.56(0.70)	1.78(0.87)	
Modified Ashworth Score_Wrist			
Baseline	1.64(0.68)	1.86(0.83)	0.78
1 month	1.47(0.61)	1.53(0.61)	
6 months	1.17(0.38)	1.19(0.47)	

*Repeated measures ANOVA

Table 3 shows there was significant improvement of functional self cares and motor recovery in both groups separately ($p<0.05$). When inter-group comparison was done between study and control groups, post treatment scores were significantly higher among the study group from baseline to 1 month and from 1to 6 months follow up. Mean score comparison of functional self care 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).

Statistically significant improvement was observed in the study group compared to control from baseline to 1 month follow up in motor function as measured by Brunnstrom scores (3.17±0.39 vs 2.83±0.38). Improve¬ment persisted in six months follow-up in the study group (4.22±0.42) compared to control (3.17±0.39) which was found to be significant. Improvement in spasticity in both elbow and wrist was observed more in study group compared to control as measured by Modified Ashworth Scale from baseline to 1 month and 6 months follow up, however it was not found to be statistically significant (P>0.05) (Table 3).

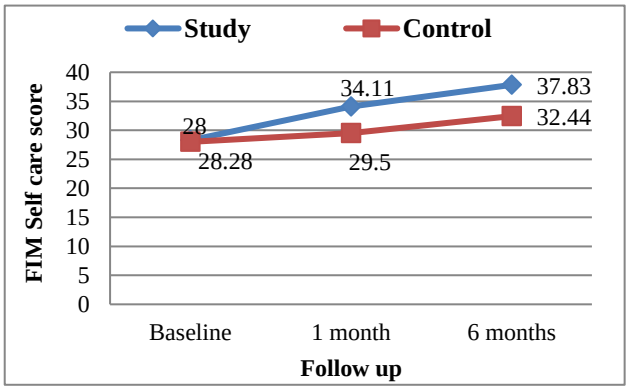

Figure 1: The trend of improvement of FIM self care score between the groups.

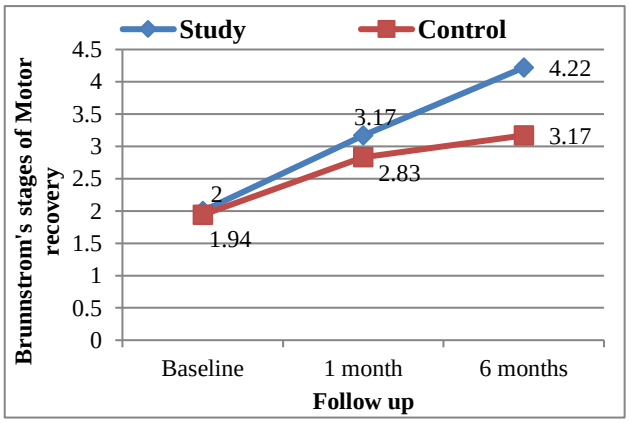

Figure 2: Trend of improvement of Brunnstrom's stages of motor recovery between the groups.

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 post treatment mean FIM Self care score was 34.11 and 37.83 at 1 and 6 months follow up respectively, which shows that in both the group post treatment 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 1.

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 post treatment mean Brunnstrom's stages of Motor recovery was 3.17 and 4.22 at 1 and 6 months follow up respectively, which shows that in both the group, post treatment improvement 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 2.

DISCUSSION

This randomized controlled study was conducted on 72 patients suffering from hemiplegia due to stroke within one year of attack. This study showed that mirror therapy combined with conventional stroke rehabilitation program provides additional benefit in terms of motor recovery and hand-related functional improvement compared with conventional stroke rehabilitation program without mirror therapy. The beneficial effect on hand functioning started at one month post treatment and continued during the 6-month follow-up evaluation. However, there was no significant improvement in spasticity.

In a literature review by Appelros P et al, shows higher incidence of stroke in male worldwide with ratios varying from 0.95-2.13.[16] In this study also males had higher incidence of stroke with a ratio of 1.5:1. Similar findings were observed in other studies conducted by Gurbuz N et al, and Dhamija et al.[17,18]

Yavuzer G et al, studied the effect of mirror therapy (5 days a week, 2-5 hours/day) in 36 patients with subacute stroke found significant improvement in the hand and upper extremity Brunnstrom stages and the FIM self-care scores compared to the control group.[12] This significant difference was still evident at the 6-month follow-up.

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 3.3±1.08 while that of control group increased to 3.2±0.67.[19] Similarly, a study by Thieme H et al15 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% 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).

Other studies also reported statistically significant improvements in both the group in all the variables measured.[20-22] However, mirror therapy group had higher post treatment scores in FIM values compared to conventional therapy group (P<0.05). Similar findings were observed in the present study.

A Cochrane review that included 14 randomized controlled studies of 567 patients reported that mirror therapy is markedly useful in the development of motor functions, with the available evidence indicating a beneficial effect on daily living activity performance and pain, with the development of motor functions continuing through 6 months post-treatment.[23] Limitations of this study are exclusion of the older age above 65 yrs in our study although incidence of ischemic stroke was more common in above 65 years and a short follow-up period. Future larger and well-designed randomized controlled trials for evaluating the effectiveness of mirror therapy at different time periods after stroke will be useful in the identification of the period when the most benefit will be observed. Further studies should be done to determine the optimum frequency and duration of mirror therapy in post stroke patients.

CONCLUSION

Mirror therapy used in addition to conventional stroke rehabilitation program was found to be effective in the development of upper extremity motor functions and daily self care activities in post stroke hemiplegic patients. Mirror therapy was not superior to the conventional treatment group regarding spasticity as measured by MAS but longer follow-up of the patients may change these results. 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 hemiplegic patients.

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