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Effectiveness of mirror therapy on upper and lower limb function among stroke patients with hemiparesis

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Original Article

Effectiveness of mirror therapy on upper and lower limb function among stroke patients with hemiparesis

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Abstract

Introduction: The upper and lower limb function impairment remains an undesirable consequence followed by a stroke that increases activity limitation. **Objective**: To find the effectiveness of mirror therapy on upper and lower limb function among stroke patients with hemiparesis admitted at Govt Medical College, Kannur. **Methods**: Quasi-experimental, non-equivalent control group pre-test post-test research design was used among 24 stroke patients with hemiparesis who met inclusion criteria by using consecutive sampling technique and allotted to both experimental (n=12) and control group (n=12). Mirror therapy was administered to the experimental group daily for two weeks. A semi-structured interview schedule and Fugl-Meyer assessment scale were used to collect data. **Results**: The study showed a significant difference between pre-test and post-test scores of upper limb function (Z=3.064), lower limb function (Z=3.076) in the experimental group, and upper limb function (Z=3.064), lower limb function (Z=3.075) in the control group. A significant improvement in post-test score of upper limb function (Z=3.050) and lower limb function (Z=2.266) among the experimental group than the control group. **Conclusion**: This study concluded that mirror therapy was useful in improving upper and lower limb function among stroke patients with hemiparesis.

Keywords: Effectiveness, hemiparesis, mirror therapy, stroke patients, upper and lower limb function

Introduction

The brain requires a continuous blood supply of around 750 – 1000 ml/min for the proper performance of neurons. Any interruption that occurs in blood flow to the brain will alter neurological metabolism within 30 seconds, will stop the metabolism within two minutes and cellular death will occur within five minutes. Stroke is considered the third killer in India (Lewis et al., 2017).

As stated by the World Health Organization (WHO), about fifteen million people have stroke globally every year. Among these, five million cases die and five million cases have long-term disability (The Internet Stroke Center, 2019).

According to Heart disease and Stroke Statistics, the highest stroke mortality rates are reported in the regions such as Eastern Europe, Central Asia, Southeast Asia, East Asia, and Sub-Saharan Africa. Worldwide statistics revealed that around 5.5 million deaths were regarded as being caused by stroke, of which 2.7 million deaths were from ischemic stroke and 2.8 million deaths from haemorrhagic stroke (American Heart Association, 2019).

Stroke may occur in any age group. Out of all strokes, about 12% of cases occur in the age above 40 years and about 34% of cases occur in the age younger than 65 years. The stroke incidence in the population differs from 154/100,000 in India (Lewis et al., 2017).

WHO defines stroke as a "clinical syndrome consisting of rapidly developing clinical signs of focal (or global in case of coma) disturbance of cerebral function

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lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin" (National Collaborating Centre for Chronic Conditions UK, 2008).

Based on the cause and pathophysiological changes, strokes are classified as ischemic and haemorrhagic. Ischemic stroke results from occlusion of an artery partially or completely due to thrombosis or emboli. Haemorrhagic stroke results from bleeding in brain tissue. Stroke may alter many functions of the body and lead to sensorimotor impairment, cognitive impairment, personality changes, and affect alteration in verbal communication, difficulty in swallowing, and elimination process (Lewis et al., 2017).

The paretic limb is a usual and unpleasant outcome of stroke that may lead to limitation of activities of daily living. For the active management of stroke, drug intake is not the only choice but also physical rehabilitation is needed. Through the intervention of physical rehabilitation with various assisting devices, the patient gets the capacity to restore motor function. It is interesting to note that significant advances have taken place in terms of technology for the treatment of stroke. The disability followed by stroke remains a matter of deep concern and mirror therapy is a solution for this problem to some extent. Mirror therapy is an easy, cost-effective, and non-invasive method to stimulate the brain (Chopra & Tamaria, 2015).

Mirror therapy intervention uses mirror illusion generated by the movement of an unaffected limb that is perceived as an affected limb and helps in neural-modulation of stroke patients. It is found to improve the motor function of the affected limb by a simple feedback mechanism (Arya, 2016).

The image reflected in the mirror tricks the brain to think that the affected limb is moving. Even though the conscious mind can understand, it is just a reflection but this mirror illusion is very useful for the brain rewiring itself through a mechanism known as neuroplasticity (Thieme et al., 2018).

Stroke victims have experienced a reduction in sensorimotor function and it leads to compromised quality of life. Favourably, mirror therapy helps to reduce or eliminate sensorimotor impairments to some extent (Hoffman, 2019). The objectives to conduct this study were-

Objectives of the atudy are to:

- Assess the upper and lower limb function among stroke patients with hemiparesis
- Find the effect of mirror therapy on upper and lower limb function among stroke patients with hemiparesis
- Find the association between upper and lower limb function with selected sample characteristics

Materials and methods

A quantitative approach using a non-equivalent control group pre-test post-test quasi-experimental research design was adopted for the study. The present study was conducted in Govt Medical College, Kannur after getting permission from the ethics committee and administrative head of Govt Medical College, Kannur. A total of 24 stroke patients with hemiparesis in the acute/sub-acute phase were selected by using a consecutive sampling technique and assigned to the experimental group (n=12) and control group (n=12). The sample size is limited due to the difficulty to meet the inclusion criteria and COVID-19 pandemic. The first selected participants were assigned to the experimental group and the next participants were assigned to the control group and thus continued until 12 participants were obtained in each group.

Sample size calculation:

$$n = (S_1 + S_2)^2 \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2}{(m_1 - m_2)^2}$$

$$n = (2.25+5.5)^2 \times \frac{(1.96+1.28)^2}{(25.36-17.36)^2}$$

$$n = 9.85175$$

Considering sample attrition of 15%

$$9.85175 \times \frac{15}{100} = 1.4777$$

Sample size is estimated to be

$$9.85175 + 1.4777 = 11.3295 \sim 12$$

The researcher collected the data from February-May 2020. Socio-demographic data (8 items) and clinical data (13 items) were collected with the help of a semi-

structured interview schedule by using Interview-Self-report and record review technique. Samples were selected as per inclusion criteria with the help of selection tools such as Mini-Mental Status Examination (6 items) was used to assess cognitive function, Modified Ashworth scale (8 items) was used to assess muscle spasticity, and Fugl-Meyer assessment scale was used to assess motor score. Participants with a range of score ≥ 24 points in Mini-Mental Status Examination, muscle spasticity stage ≤2 on the Modified Ashworth Scale and motor score range from 85-95 on the Fugl-Meyer assessment scale were selected for this study. Thereafter, the Fugl-Meyer assessment scale was used to assess the sensorimotor function of the upper and lower limb for 20 minutes by using observation techniques. Both groups received conventional therapy such as physiotherapy and drugs.

Table 1: Interpretation of cognition score by Mini Mental Status Examination

Range of score	Severity of cognitive impairment
24-30	No cognitive impairment
19-23	Mild cognitive impairment
10-18	Moderate cognitive impairment
<9	Severe cognitive impairment

Table 2 : Interpretation of muscle spasticity by Modified Ashworth scale

Range of score	Muscle tone
0	Normal tone
1	Slight increase in muscle tone at the end of the ROM
1+	Slight increase in muscle tone throughout the ROM
2	More marked increase in muscle tone through most of the ROM
3	Considerable increase in muscle tone passive movement difficult
4	Affected part rigid in flexion or extension

Table 3:
Interpretation of impairment severity by Fugl-Meyer assessment scale

Range of score	Severity impairment
<84	Hemiplegia
85-95	Hemiparesis
96-99	Slight motor discoordination
100	Normal motor performance

Mirror therapy refers to an intervention of arm exercises (Hand, wrist, and finger exercises) and leg exercises (Foot and finger exercises) with the use of a mirror box made up of cardboard with size 40*30 cm for 30 minutes daily for two weeks. Mirror therapy was administered to the experimental group until discharge and the primary caregiver performed a return demonstration before discharge. Participants were instructed to perform mirror therapy for 14 days. A mirror box and checklist of arm and leg exercises were also given to them. Follow-up was done by the researcher over phone calls and marked in the phone call checklist. Post-test was done by Fugl-Meyer assessment scale for the sensorimotor function of the upper and lower limb on the 14th day of therapy. Data were analyzed and presented as mean, median, and standard deviation. Non-parametric tests such as Wilcoxon signed rank test, Mann-Whitney U test, and Chi-square test was used for this study due to the very small sample size and ordinal scale of measurement.

Results

Table 4: Distribution of Subjects Based on Sample Characteristics

N = 24

Sample characteristics	Experimental group (n=12)		Control group (n=12)	
	f	%	f	%
Socio-demographic data				
Age				
41-50 years	2	16.7	1	8.3
51-60 years	2	16.7	1	8.3
61-70 years	4	33.3	5	41.7
71-80 years	4	33.3	5	41.7
Gender				
Male	7	58.3	7	58.3
Female	5	41.7	5	41.7
Marital status				
Married	8	66.7	8	66.7
Widow	3	25.0	2	16.7
Widower	1	8.3	2	16.7

Sample characteristics	Experimental group (n=12)		Control group (n=12)	
	f	%	f	%
Educational status				
No formal education	1	8.3	1	8.3
Primary education	5	41.7	6	50.0
Secondary education	2	16.7	3	25.0
High school	4	33.3	2	16.7
Monthly income				
5,001-15,000 rupees	3	25.0	-	-
<5,000 rupees	7	58.3	10	83.3
No income	2	16.7	2	16.7
Habit of smoking				
Yes	3	25	3	25
No	9	75	9	75
Habit of alcoholism				
Yes	3	25	3	25
No	9	75	9	75
Diet				
Mixed	12	100	12	100
Clinical data				
Type of stroke				
Ischemic	12	100	12	100
Duration of stroke				
0-1 month	12	100	12	100
Paretic side				
Right side	7	58.3	7	58.3
Left side	5	41.7	5	41.7
Dominant side				
Right side	12	100	12	100
Physical exercises				
Never	10	83.3	7	58.3
Daily	1	8.3	3	25
Weekly once	-	-	1	8.3
Rarely	1	8.3	1	8.3
Previous history of stroke delete this if not there				
No	12	100	12	100
Caregiver support satisfaction				
Yes	12	100	11	91.7
No	-	-	1	8.3
History of brain disease				
No	12	100	12	100
Rating depression				
Never	4	33.3	3	25
Sometimes	7	58.3	7	58.3
Always	1	8.3	2	16.7
Feeling of trust towards healthcare provider				
Yes	12	100	11	91.7
No	-	-	1	8.3
Previous knowledge regarding stroke				
Yes	3	25	4	33.3
No	9	75	8	66.7
Easily accessible healthcare system				
Yes	6	50	9	75
No	6	50	3	25
Associated illness				
Hypertension	11	91.3	9	75.0
Diabetes mellitus	5	41.7	6	50.0
Heart disease	4	33.3	1	8.3
Others	-	-	1	8.3

Table 4 shows that the majority of the participants in the experimental group (33.3%) and the control group (41.7%) are above 70 years of age. All participants were 41 years and above. There was an equal gender-wise distribution of participants in the experimental and control group i.e., 58.3% were males, and 41.7% were females, respectively. About 66.7% of participants were married in both the experimental and control group. Most of the participants (41.7% in the experimental group and 50% in the control group) had undergone primary education. The majority of the participants (58.3% in the experimental group and 83.3% in the control group) had a monthly income of < Rs 5000/-. Only 25% of the participants in both the experimental and control groups had a habit of smoking and alcoholism. All participants were taking a mixed diet in both experimental and control groups. All participants had an ischemic stroke with 0-1 month duration in both experimental and control groups. Out of these participants with stroke, 58.3% had right side paresis and 41.7% had left side paresis in both experimental and control groups. The dominant side of all participants with stroke was the right side in both experimental and control groups. Most of the participants, 83.3% in the experimental group and 58.3% in the control group had never performed physical exercises. No one had any previous history of stroke or brain diseases in both the experimental and control groups. The majority of participants, 100% in the experimental group and 91.7% in the control group were satisfied with caregiver support and feeling of trust towards healthcare providers. Most of the participants (58.3%) in both the experimental and control groups had reported depression sometimes or the other. Among the participants, 25% and 33.3% in the experimental group and control group had previous knowledge regarding stroke. About 50% of the participants in the experimental group and 75% of the participants in the control group had an easily accessible healthcare system. The majority of the participants, 91.3% in the experimental group and 75% in the control group had hypertension. Out of these participants, 41.7% in the experimental group and 50% in the control group had diabetes mellitus. Among the participants, 33.3% in the experimental group and 8.3% in the control group had heart disease. About 8.3% of the participants in the control group had other diseases such as hypothyroidism.

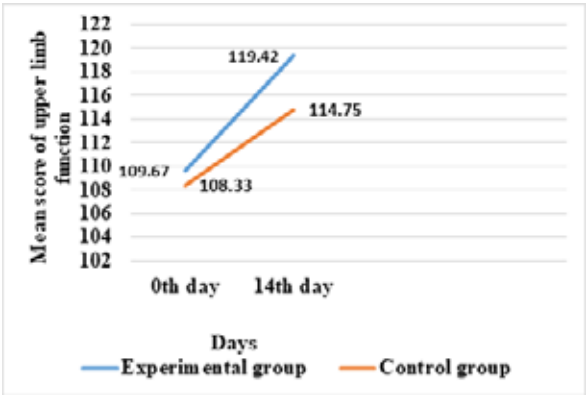

Figure 1: Distribution of pre-test and post-test mean scores of upper limb function within the experimental and control group

Figure 1 shows that the pre-test and post-test mean scores of upper limb function within the experimental group are increased from 109.67 to 119.42, whereas in the control group, the mean score is increased from 108.33 to 114.75. There was a significant change in the mean score of upper limb function in both the experimental and control group, but the increase was more among the experimental group.

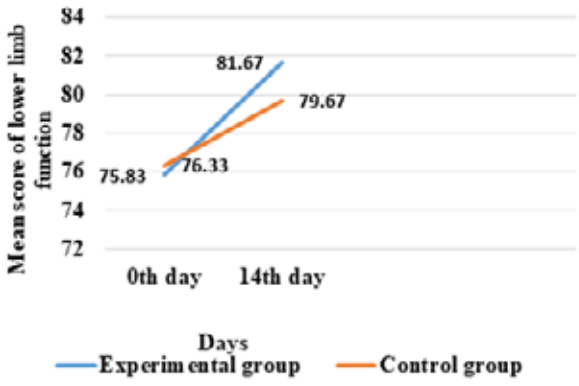

Figure 2: Distribution of pre-test and post-test mean scores of lower limb function within the experimental and control group

Fig 2 shows that the pre-test and post-test mean scores of lower limb function within the experimental group are increased from 75.83 to 81.67, whereas in the control group, the mean score is increased from 76.33 to 79.67. There was a significant change in the mean score of lower limb function in both the experimental and control group, but the increase was more among the experimental group.

Table 5: Significance of Difference between Pre-test and Post-test Scores of Upper Limb Function in Experimental and Control Group

N = 24

	Experimental group (n=12)			Control group (n=12)			
	Mean	SD	Z value	Mean	SD	Z value	P-value
0th day	109.67	3.798	3.064	108.33	4.677	3.064	0.002
14th day	119.42	3.260		114.75	3.137		

Significant at .05 level

Data presented in Table 5 reveals that the calculated Z value (3.064) obtained from pre-test and post-test scores of upper limb function in the experimental and control group is greater than the table value (1.96) at .05 level of significance by using Wilcoxon signed rank test. Hence, it is evident that there is a significant difference between pre-test and post-test scores of upper limb function in the experimental and control group.

Table 6: Significance of Difference between Pre-test and Post-test Scores of Lower Limb Function in Experimental and Control Group

N = 24

	Experimental group (n=12)			Control group (n=12)			
	Mean	SD	Z value	Mean	SD	Z value	P-value
0th day	75.83	3.040	3.076	76.33	2.188	3.075	0.002
14th day	81.67	2.387		79.67	1.670		

Significant at .05 level

Data presented in Table 6 reveals that calculated Z value (3.076) obtained from pre-test and post-test scores of lower limb function in the experimental group and calculated Z value (3.075) obtained from pre-test and post-test scores of lower limb function in the control group are greater than the table value (1.96) at .05 level of significance by using Wilcoxon signed rank test. Hence, it is evident that there is a significant difference between pre-test and post-test scores of lower limb function in the experimental and control group.

Table 7: Significance of Difference in Post-test Score of Upper and Lower Limb Function between Experimental and Control Group

N = 24

	Experimental group (n=12)		Control group (n=12)			
	Mean	SD	Mean	SD	Z value	P-value
Upper limb	119.42	3.260	114.75	3.137	3.050	0.002
Lower limb	81.67	2.387	79.67	1.670	2.266	0.023

Significant at .05 level

Data presented in Table 7 reveals that calculated Z value (3.050) obtained from the post-test score of upper limb function between the experimental and control group and calculated Z value (2.266) obtained from the post-test score of lower limb function between experimental and control group is greater than the table value (1.96) at 0.05 level of significance by using Mann-Whitney test. Hence, it is evident that there is a significant difference in post-test scores of upper and lower limb function between the experimental and control group. This result indicates that mirror therapy is effective in upper and lower limb function among stroke patients with hemiparesis.

The computed $\chi 2$ value for the association between upper and lower limb function with selected sample characteristics such as age, gender, the habit of smoking, the habit of alcoholism, paretic side, and physical exercises are less than the table value at .05 level of significance. Therefore, it indicates that there is no association between upper and lower limb function with these selected variables.

Hence, it is concluded that mirror therapy is effective in upper and lower limb function among stroke patients with hemiparesis.

Discussion

The present study revealed that the mean score and standard deviation of upper limb function in the experimental group were (Mean±SD=109.67±3.798) on the 0th day and (Mean±SD=119.42±3.260) on the 14th day; whereas in the control group it was

(Mean±SD=108.33 ±4.677) on the 0th day and (Mean±SD=114.75 ±3.137) on 14th day. Hence, there was a significant change in the mean score of upper limb function in the experimental and control group, but more improvement in the experimental group.

The findings of the present study are similar to the study conducted to find the effect of mirror therapy on upper extremity motor functions in stroke patients at Mangalore. The study result showed that the pre- and post-intervention mean FGMR scores and SD of the upper limb in the mirror therapy group are 29.27±12.56 on the 0th day and 41.54±9.96 on the 28th day respectively, whereas in the control group are 26.72±11.30 on the 0th day and 32.72±9.72 on 28th day, respectively. The study showed a significant difference between pre- and post-intervention FGMR total scores of the upper limb in the mirror therapy group (Shanavas, 2012).

The present study findings showed that the calculated Z value of lower limb function in the experimental and control group were 3.076 and 3.075 between the 0th day and 14th day by using Wilcoxon signed rank test. There was a significant difference between pre-test and post-test scores of lower limb function in the experimental and control group. The study findings showed that the calculated Z value of lower limb function between the experimental and control group was 2.266 on 14th day at 0.05 level of significance by using the Mann-Whitney U test. Hence, study results revealed that mirror therapy is effective in lower limb function among stroke patients with hemiparesis.

The study conducted to assess the efficacy of mirror therapy on lower extremity motor recovery and functional ability after a stroke in Nigeria showed similar results. The study result showed that the Z value of FMA-LE score between baseline and post-intervention in the experimental and control group were 2.816 and 2.887 by using Wilcoxon signed rank test, there was a statistically significant difference in lower limb motor improvement in the experimental and control group. The study result showed that the Z value of FMA-LE post-test score between experimental and control group was 2.433 by using Mann-Whitney U test, there was a statistically significant difference between experimental and control group. Hence, study results revealed that mirror therapy is more effective than the control group in improving the lower limb function among stroke patients (Mahmoud & Muhd, 2016).

Conclusion

The mirror therapy was performed daily for 30 minutes for two weeks in stroke patients with hemiparesis can improve upper and lower limb function. Mirror therapy serves as a non-invasive and non-pharmacological intervention in the improvement of upper and lower limb function. The effect of mirror therapy is more pronounced in the improvement of motor performance of upper and lower limb function among stroke patients with hemiparesis.

Limitations

The generalization of the findings is limited due to the smaller sample size. The researcher had limited control over extraneous variables such as physical, psychological, and economical factors. The study was done in a single setting for short duration i.e., two weeks.

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ReferenceWs

Arya K. N. (2016). Underlying neural mechanisms of mirror therapy: Implications for motor rehabilitation in stroke. Neurology India, 64(1), 38–44. https://doi.org/10.4103/0028-3886.173622

American Heart Association (2019). Heart Disease and Stroke Statistics-2019 At-a-Glance. Retrieved from https://healthmetrics.heart.org/wp-content/uploads/2019/02/At-A-Glance-Heart-Disease-and-Stroke-Statistics-%E2%80%93-2019.pdf

Charu Chopra PT., Savita Tamaria PT (2017). Mirror Therapy in Stroke Rehabilitation. International Journal of Science and Research (IJSR), 4(7); 660-663. https://www.ijsr.net/search_index_results_paperid.php?id=SUB156438

Hoffman, H. (2019). Mirror Box Therapy Exercises for Stroke Recovery. Retrieved from https://www.saebo.com/blog/mirror-box-therapy-exercises-stroke-survivors/

Lewis, S.L., Dirksen, S.R., Heitkemper, M.M., Bucher, L., & Harding, M.M. (2017). Medical-Surgical Nursing: Assessment and Management of Clinical Problems (10th ed.). New Delhi: Elsevier Publishers.

Mahmoud Y.U, Muhd S.A. (2016). Efficacy of mirror therapy in improving motor recovery and functional ability of the hemiparetic lower limb after stroke. Adv Sci Med, 1(4), 14-19. https://zenodo.org/record/1308585#.X8ILL2gzbIU.

Mohammed Shanavas, J (2012) A study to evaluate the effect of mirror therapy on upper extremity motor functions in stroke patients. The Tamilnadu Dr. MGR Medical University. Retrieved from http://repository-tnmgrmu.ac.in/id/eprint/2896

National Collaborating Centre for Chronic Conditions UK (2008). Stroke: National Clinical Guideline for Diagnosis and Initial Management of Acute Stroke and Transient Ischaemic Attack (TIA). London: Royal College of Physicians (UK); (NICE Clinical Guidelines, No. 68.) 1, Introduction. Available from: https://www.ncbi.nlm.nih.gov/books/NBK53302/

The Internet Stroke Center (2019). Stroke statistics. Retrieved from http://www.strokecenter.org/patients/about-stroke/stroke-statistics/

Thieme, H., Morkisch, N., Mehrholz, J., et al. (2018). Mirror therapy for improving motor function after stroke. The Cochrane database of systematic reviews, 7(7), CD008449. https://doi.org/10.1002/14651858.CD008449.pub3