

## Combined Effect of Mirror Therapy and Thermal Stimulation on Upper Extremity Motor Functions in Post Stroke Hemiparetic Subjects

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### Abstract

**Introduction:** Stroke is the leading cause of long term disability among adults and hemiparesis is the most common impairment after stroke. Longitudinal studies of recovery after stroke suggest that on 50% of patients with significant arm paresis recover useful function [1] WHO estimated that in 1990, out of a total of 9.4 million deaths in India, 619,000 were due to stroke. This gives a stroke mortality rate of 73 per 1000,000 (estimated total population 849 million). It is estimated that 600,000 Americans suffer a first stroke each year, and the nation's nearly 4 million stroke survivors are living with consequences [2]. Patient diagnosed with stroke often present with a combination of muscle weakness or muscle imbalance, decreased postural control, muscle spasticity, poor voluntary control, and body mal-alignment [3]. **Aims of the Study:** To analyze the effectiveness of combine motor rehabilitation protocol to improve upper extremity motor recovery in post stroke subjects. **Methods:** On the basis of inclusion and exclusion criteria 30 subjects were randomly divided into two groups. 15 subjects in experimental group (Group A) given mirror therapy and thermal stimulation and 15 subjects in controlled group (Group B). Given general exercises of upper extremity for flexors and extensors were carried out for 4 weeks including active exercises and functional training. **Discussion:** In the present study, aspect of somatosensory stimulation and mirror illusion of normal movement is taken as a point of reference for treatment in hemiplegic with functional dependence on the basis of UEFI. [5,8]. There is a significant change in post intervention in Group A  $p \leq 0.05$  which approves improvement in functional activity according to UEFI. The use of mirror therapy creates the mirror illusion of normal movement of the affected hand may substitute for decreased proprioceptive information, thereby helping to recruit the premotor cortex and assisting rehabilitation through an intimate connection between visual input and premotor areas. Clinically this study demonstrated that by using mirror therapy and thermal stimulation as a treatment tool, the improvement was seen in upper extremity functional activity of post stroke hemiparetic subjects. **Conclusion:** Mirror therapy and thermal stimulation was found to be effective in improving functional independence in upper limb post sub-acute stroke. When mirror therapy and thermal stimulation is administered to patients suffering from sub-acute stroke over a period of 4 weeks, it results in an improvement in reaching forwards, grasping, manipulating objects and also improves other fine motor functions of the hand. **Future Research:** 1. Further studies are recommended to minimize these limitations in such a way that larger sample sizes of both the sexes that include various age groups of people are studied. 2. The duration of study can be increased. 3. The inclusion criterion can be improved so that all the subjects show similar functional independence in upper limb at the beginning of the study. 4. Various outcome measures can be used in order to record the functional independence in a better way. 5. Study can also be done to improve lower extremity functions. 6. Study can be done on chronic patients. **Limitations of the Study:** 1. The duration of study was only 4 weeks, so further prognosis and long term benefits could not be recorded. 2. Home exercises were not prescribed to the subjects. 3. Training depends on functional level of patients. 4. Task specificity and stroke severity are important factors in rehabilitation of upper limb. 5. It is difficult to maintain constant temperature. 6. Thermal stimulation cannot be performed on patients with sensory loss.

**Keywords:** Mirror Therapy; Thermal Stimulation Medium Size Ball; Suitcase; Shirt With Buttons; Comb; Plinth; Mirror; Hot and Cold Packs; Medium Size Jar; Chair; Towels & Shoes With Laces.

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## Introduction

Stroke is the leading cause of long term disability among adults and hemiparesis is the most common impairment after stroke. Longitudinal studies of recovery after stroke suggest that on 50% of patients with significant arm paresis recover useful function [1].

Analysis of community surveys from different regions of India shows a crude stroke prevalence rate of about 203 per 1000,000 populations above 20 years of age, amounting to a total of about 1 million cases. The male to female ratio was estimated to be 1.7 WHO estimated that in 1990, out of a total of 9.4 million deaths in India, 619,000 were due to stroke. This gives a stroke mortality rate of 73 per 1000,000 (estimated total population 849 million). It is estimated that 600,000 Americans suffer a first stroke each year, and the nation's nearly 4 million stroke survivors are living with consequences [2].

Patient diagnosed with stroke often present with a combination of muscle weakness or muscle imbalance, decreased postural control, muscle spasticity, poor voluntary control, and body mal-alignment [3].

In many patients with severe stroke, the affected upper limb (UL) never becomes useful, even after therapy. Only about 15% of those suffering from severe stroke recover hand functions [4].

The paretic upper limb is a common and undesirable consequence of stroke that increases activity limitation. It has been reported that up to 85% of stroke survivors experience hemiparesis and that 55% to 75% of stroke survivors have continued to have limitations in upper extremity functioning [5].

It has been estimated that 55% of stroke survivors have a nonfunctional upper extremity following initial therapy and 30% of stroke survivors have had some partial recovery of upper extremity functions in terms of range of motion and strength, but are still unable to perform ADLs with the affected upper extremity, which negatively affects their independence and increases the burden of care [6].

When a stroke patient puts his weakened hand in the mirror box and moves his strong hand, the mirror box gives the illusion movements occurring in the hand affected by the stroke. This is done through activation of mirror neurons in the premotor cortex of the brain. In essence the mirror tricks the mind and weak hand into working better [7].

Thermotherapy refers to the application of heat or cold (cryo therapy) for the purpose of changing the cutaneous, intra-articular and core temperature of soft-tissues with the intention of improving the symptoms of certain conditions. Thermal stimulation has been developed to promote upper extremity recovery in stroke patients because thermal stimulation may induce cortical reorganization [8].

### *Operational Definition of Stroke*

Stroke is classically characterized as a neurological deficit attributed to an acute focal injury of the CNS by a vascular cause, including cerebral infarction, intracerebral hemorrhage (ICH) and subarachnoid hemorrhage and is a major cause of disability and death.

The current World Health Organization definition of stroke, introduced in 1970 and still used is "rapidly developing clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin [9].

### *Operational Definition of Mirror Therapy*

Ramchandran originally hypnotized that paralysis following might have a learnt component, which would possibly be 'unlearnt' by means of mirror illusion. Mirror therapy might be a form of visually guided motor imagery. Mirror illusion increases activity in precuneus and posterior cingulate cortex associated areas associated with awareness of self and spatial attention.

### *Operational Definition of Hemiplegia*

In medical jurisprudence. Unilateral paralysis; paralysis of one side of the body, commonly due to a lesion in the brain. In the cerebral form, the hemiplegia is sometimes "alternate" or crossed, that is occurring on the opposite side of the body from the initial lesion.

### *Statement of Question*

Will mirror therapy and thermal stimulation improve the upper extremity motor recovery in hemiparesis patients?

### **Research Hypothesis**

*Experimental Hypothesis:* This hypothesis states that thermal stimulation and mirror therapy will

improve the motor recovery of paretic upper extremity in post stroke hemiparetic subjects.

*Null Hypothesis:* This hypothesis states that mirror therapy and thermal stimulation may or may not improve upper extremity functions in stroke cases.

#### *Need of the Study*

As there is decreased functional activity of upper extremity among stroke subjects so this study being done to improve the functional activity of upper extremity and to improve the quality of life in hemiplegic subjects.

#### *Aims of the Study*

To analyze the effectiveness of combine motor rehabilitation protocol to improve upper extremity motor recovery in post stroke subjects.

### **Review of Literature**

- Hung-Chia Wu, Yu Cing Lin et al. (2010); conducted a comparative study on effect of thermal stimulation on upper extremity motor recovery 3 months after stroke and concluded that upper extremity thermal stimulation programme could provide further improvement in motor function of upper extremity, than those in the controlled group after 3 months of onset [8].
- Holm Thieme, Jan Mehrholz et al. (2013); conducted a study on mirror therapy for improving motor function after stroke and concluded that the mirror therapy could be applied at least as an additional intervention in the rehabilitation of patients after stroke [10].
- Sneha S. Khandare, Singaravelan, Subash M Khatri (2013); compared task specific exercises and mirror therapy to improve upper limb functions in sub-acute stroke patients and concluded that mirror therapy can be added along with task specific exercises in the treatment of sub-acute stroke patients to improve upper limb function [11].
- Andreas Stefan Rothgangel et al. (2011); conducted a study on the clinical aspects of mirror therapy in rehabilitation a systemic review of literature and concluded that the work on mirror therapy needs to be considered in the context of any new treatment modality [17].
- Youn Jookang, Jeonghun Ku et al. (2011); conducted a study on facilitation of corticospinal excitability according to motor imagery and mirror therapy in healthy subjects and stroke patients and concluded that in both groups corticospinal excitability was facilitated by viewing the mirror image of the activity of the ipsilateral hand. These findings provide neurophysiological evidence supporting the application of various mirror imagery programmes during stroke rehabilitation [18].
- Rinu Susan Raju, Prabhakaran S Sharma Jeyaraj D Pandian (2010); conducted a study to analyze psychosocial problems, quality of life and functional independence among Indian stroke survivors and concluded that presence of anxiety, depression and functional dependence were associated with impaired quality of life. There was low prevalence of anxiety and depression [20].
- Peter Appetros, Birgitta Stegmeyer, and Andrews Terent; (2009); conducted studies on sex differences in stroke epidemiologies and shown that stroke is more common in men than in women and concluded that stroke is more common among men but women are more severely ill [21].
- Staphanie E Chiuve, Kathryn et al. (2008); conducted a study on primary prevention of stroke by healthy lifestyle and concluded that a low-risk life style that is associated with a reduced risk of multiple chronic diseases also may be beneficial in the prevention of stroke especially ischemic stroke [24].
- Syamal K. Das, Tapas K. Banerjee, Atanu Biswas, et al. (2008); conducted a survey on stroke; an Indian scenario and gives an analysis that stroke in India is very much on rise [25].
- A Williams Andrews, Stephen E, Folger, et al. (2008); conducted a study on examination of test and measures used most frequently by specialists index of adult stroke and concluded that the result of this study do not identify test and measures that clinicians should use [26].
- Hazhir Sikaroodi, Mehmood Moalmedi et al.(2007); conducted a study on stroke as first manifestation of takayasu arteritis and concluded that neurological involvement is not common in Takayasu disease and neurological syndromes as first manifestation of disease are relatively rare [27].
- Jeyaraj D Pandian, Velandai Shrikanth et al; 2007; Oct; 22; Journal of American heart

- association; Vol38; 3063-3069; conducted a study on poverty and stroke in India. A time to Act and concluded that stroke must be a priority on the health agenda in India and other developing countries [28].
- M.D Patel, C Mcevitt et al. (2007); conducted a study on clinical determinants of long term quality of life after stroke and concluded that determinants of health related Quality of life after stroke whether physical or psychosocial aspects of health related quality of life after are being considered. This study provides variable information on factor predicting long term health related quality of life, which can be undertaken into consideration in audits of clinical practice or in future interventional studies aiming to improve health related quality of life after stroke [29].
  - Larry B Goldstien, Robert Adams et al. (2006); conducted a study on primary prevention of ischemic stroke and concluded that extensive evidence is available identifying a variety of specific factors that increases the risk of a first stroke and providing strategies for reducing that risk [30].
  - Nathank Le, Stephen et al. (2006); conducted a study on muscle impairments and behavioral factors mediate functional limitations and disability following stroke and concluded that the findings warrant future studies to determine whether strength and power, depressive symptoms and low self-efficacy effectively improves function, reduce disability and enhance quality of life in people who have survived stroke [31].
  - Lara Cairio, Jose M. Ferro et al. (2006); conducted a study on depression in acute stroke and concluded that depression was present in almost one-half of the acute stroke patients and was related to previous mood disorder but not to stroke type and location [32].
  - Haacke, Astrid Althaus et al. (2006); performed a study on long term outcome after stroke and concluded that a substantial proportion of stroke survivors has very poor health related Quality of life [33].
  - Tapas Kumar Banerjee, Shayamal Kumar Das. (2006); conducted a study on epidemiology of stroke in India and concluded that there was higher prevalence of cerebral hemorrhage in the community compared to that in western countries [2].
  - Caroline Haacke,, Astrid Althaus et al. (2006); conducted a study on long term outcome after stroke and concluded that a substantial proportion of stroke survivors has very poor health related QOL [34].
  - Marc Fisher et al. (2005); conducted a study on enhancing the development and approval of acute stroke therapies and concluded that the development of additional acute stroke therapies represents a large unmet need with many remaining challenges and also opportunities to incorporate novel approaches to clinical trial design that will lead to regulatory approval [35].
  - Rosmary Martino, Norine Foley et al. (2005); conducted a study on dysphagia after stroke and concluded that the high incidence of dysphagia and pneumonia is a consistent findings with stroke patients. The pneumonia risk is greatest in stroke patients with aspiration [36].
  - Lars Peter Kammersgaard, H.S et al. (2004); conducted a stroke study on short and long term prognosis for very old stroke patients and concluded that very old age per se was a strong predictor of outcome and mortality after stroke. Apart from very old age factors such as pre stroke medical and functional status and onset stroke severity should be taken into consideration when planning treatment and rehabilitation after stroke [37].
  - Pamela Duncan, Staphanie Studenski et al. (2003); conducted a randomized controlled trial of therapeutic exercises in sub-acute stroke and concluded that the structured progressive programme of therapeutic exercises in persons who had completed acute rehabilitation services produced gains in endurance, balance and mobility and those attributable to spontaneous recovery and usual care [38].
  - Wilma M. Hopman, Jane verner et al. (2003); conducted a study on quality of life during and after inpatient stroke rehabilitation and concluded that substantial gains in health related quality of life during inpatient rehabilitation may not be sustained after discharge [39].
  - Stefano Parlucci, Gabriella et al. (2003); conducted a functional outcome of ischemic and hemorrhagic stroke patients after inpatient rehabilitation and concluded that the results of this study provide further evidence of better functional prognosis in stroke survivors with hemorrhage stroke [40].



- Stephen Bagg, Alica Paris et al. 2002; Journal of American Heart Association; Vol 33; 179-185; conducted a study on effect of age on functional outcomes after stroke and concluded that the small amount of variation that can be explained by age alone and questionable clinical relevance of such a small effect suggest that there is no justification to patients access to rehabilitation solely because of advanced age [41].
- Thomas A Pearson, Steven N Blair et al. (2002); Journal of American Heart Association updated a guide to comprehensive risk education for adult patients without coronary or other atherosclerotic vascular disease and concluded that practice based systems for risk factor monitoring reminders and support services need to be established, reimbursed and otherwise supported by managed care organizations and third party payers [42].
- Philippa J. Clarke, Joanne M Laurence, Sandra E Black et al. (2000); conducted a study on changes in quality of life over the first year after stroke and concluded that the quality of life of stroke survivors exists throughout the first year of recovery [43].
- L.R Wilason, S.C Gandevia et al. (1999); Journal of Neurology conducted a study on muscle spindle activity in the affected upper limb after a unilateral stroke and concluded that any fusimotor dysfunction is likely to make a mirror contributions to the patients disability [44].
- Rosmarie B King et al. (1996); conducted a study on Quality of life after stroke and concluded that the identification of depression, social support and functional status on predictors Quality of life suggests the need to assist stroke survivors in coping and in maintaining and strengthening their support systems [45].

## Methodology

Thirty (30) men and women subjects (45-65years) with radiological diagnosis of stroke and post stroke residual weakness of Upper Extremity and were willing to take treatment for 4 week sessions. and study was done in SGRRIMHS/SMIH department of physiotherapy at Patel Nagar Dehradun. The Subjects were randomly divided into 2 groups. Inclusion criteria, GCS=15, MMSE=30, Both male and female subjects., First ever stroke, MAS<3, Good sitting balance, Sub-acute stroke (4-6 wks.), Impairment of hand functions & Age group 45-65yrs. Subjects were excluded Uncooperative

patients, Cognitive impairments, Global aphasia, Any previous injury (fracture) or nerve injury, Sensory impairments, Skin infections & Any visual impairment. All subjects were given verbal instructions for the procedure and consent form was obtained from each one of them, prior to participation in the study.

### *Instructions to the Patient*

1. Subjects were asked to be regular for the treatment sessions as deemed by the researcher.
2. Subjects were asked to report any discomfort during the study period and briefed about the use of safety switch

### *Procedure*

On the basis of inclusion and exclusion criteria 30 subjects were randomly divided into two groups. 15 subjects in experimental group (Group A) given mirror therapy and thermal stimulation and 15 subjects in controlled group (Group B). given general exercises of upper extremity for flexors and extensors were carried out for 4 weeks including active exercises and functional training. Consent was taken after explanation of the procedure and its outcomes. A pretreatment scoring was done via Upper Extremity Functional Index (UEFI) in which the subjects were asked to do the following activities:

1. Lifting a bag of groceries to the waist level
2. Lifting a bag of groceries above your head.
3. Throwing a ball as shown in figure 4.
4. Dressing
5. Grooming your hair as shown in figure 4.5.
6. Opening door
7. Tying or lacing shoes
8. Opening a jar as shown in figure 4.6
9. Doing up buttons.
10. Carrying a small suitcase with your affected limb.



Fig. 1: Showing instruments used in the study

After performing the activities we were asked the subjects to score each activity himself or herself according to UEFI score.

- 0 = Extreme difficulty or unable to perform the activity
- 1 = Quite a bit of difficulty
- 2 = Moderate
- 3 = A little bit of difficulty
- 4 = No difficulty.

In Experimental group a pre scoring was done via UEFI and after scoring, the patient is seated close to a table in which a mirror (35\*35cm) was placed vertically as shown in Figure 3. The involved hand is placed behind the mirror and the non-involved hand in front of the mirror. The practice consisted of non-paretic side wrist and finger flexion and extension movements while patient looked into the mirror watching the image of their non-involved hand, thus seeing the reflection of the hand movements projected over the involved hand. Patients could only see the non-involved hand in the mirror; otherwise the noninvolved hand is hidden from sight. During the session the patient is asked to try to do the same movements with the paretic hand while he is moving the non-paretic hand. The subjects performed the exercises for 30 minutes for mirror therapy and 30 minutes of thermal stimulation for 6 days per week for a consecutive 4 weeks. On the other hand during thermal stimulation Intervention on upper extremity, the heating pad was put on the paretic hand 15 minutes as shown in (Figure 2). Participants were encouraged to withdraw or move the paretic hand from the heating pad when discomfort occurred. After that

cold stimulation procedure began and the patient was asked to do the same procedure. A session of thermal stimulation entailed alternate cycles of heat and cold stimulation. While in controlled group general exercises of upper extremity for flexors and extensors were carried out for 4 weeks including active exercises and functional training.



Fig. 3: Showing patient doing exercises in mirror



Fig. 4: Showing patient throwing a ball



Fig. 2: Showing applying thermal stimulation via heating pads



Fig. 5: Showing patient doing combing



Fig. 6: Showing patient doing opening the jar

### Result and Interpretation

#### Statistical Analysis

The appropriate statistical analyses were conducted using the Statistical Package for Social Sciences 11.0. All data were entered into SPSS files from a standardized data form at the time of data collection. Prior to analysis, all entries were verified by comparing the recorded data in each file to a printed copy of the data files entered into SPSS. All results were presented as mean standard deviation. All significant p values (~0.05) were indicated in bold type. Frequencies were used to test the data for normality around the mean (data not shown).

#### Hypothesis Testing For Comparing Two Related Samples

Paired t- test is a way to test for comparing two related samples, involving small values of *n* that does not require the variances of the two populations to be equal, but the assumption that the two populations are normal must continue to apply. For paired t- test, it is necessary that the observations in the two samples be collected in the form of what is called matched pairs i.e., “each observation in the one sample must be paired with an observation in the other sample in such a manner that these observation are somehow “matched” or related, in an attempt to eliminate extraneous factors which are not of interest in test.” Such a test is generally considered appropriate in a before and after treatment study. For instance, we may test a group of certain students before and after training in order to know whether the training is effective, in which situation we may use paired t- test.

The paretic upper extremity motor functions were significantly different as described in [Table 1] which is showing the descriptive statistics of UEFI of pre and post scores between the two groups.

Improvement in the upper extremity motor functions also revealed statistically significant differences between the two groups  $p < 0.05$  in [Table 2].

Table 1: Descriptive Statistics of Upper Extremity Functional Index Pre and Post Score of Experimental and Control Group

	Age	Experimental Group		Age	Control Group	
		Pre	Post		Pre	Post
Mean	53.0667	14.7333	18.6667	57.6000	8.4000	11.6000
Std. Error of Mean	1.60198	1.29639	1.31897	1.55165	.46599	.42314
Std. Deviation	6.20445	5.02091	5.10835	6.00952	1.80476	1.63881
Variance	38.495	25.210	26.095	36.114	3.257	2.686
Range	18.00	19.00	18.00	17.00	6.00	5.00
Sum	796.00	221.00	280.00	864.00	126.00	174.00

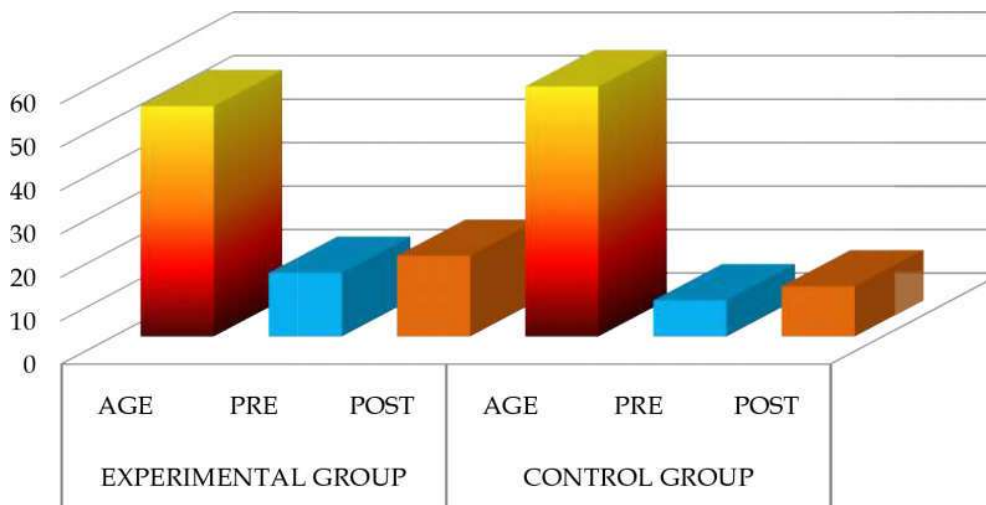
Table 2: Paired Samples Test of Upper Extremity Functional Index Pre and Post Score of Experimental and Control Group

	Mean	Std. Deviation	Paired Differences Std. Error Mean	95% Confidence Interval of the Difference Lower Upper		t	DF	Sig. (2- tailed)
Pre Experimental Group - Post Experimental Group	-3.93333	.79881	.20625	-4.37570	-3.49097	-19.071	14	.000
Pre Control Group - Post Control Group	-3.20000	.77460	.20000	-3.62896	-2.77104	-16.000	14	.000
Pre Experimental Group - Pre Control Group	6.33333	5.53775	1.42984	3.26663	9.40004	4.429	14	.001
Post Experimental Group - Post Control Group	7.06667	5.56092	1.43582	3.98713	10.14620	4.922	14	.000

**Table 3:** Correlations of Upper Extremity Functional Index Pre and Post Score of Experimental and Control Group

		Age Experimental Group	Pre Experimental Group	Post Experimental Group	Age Control Group	Pre Control Group	Post Control Group
Spearman's rho	Age Experimental Group	1.000	-.217	-.253	-.050	.069	.028
	Pre Experimental Group	-.217	1.000	.978**	.233	-.147	-.096
	Post Experimental Group	-.253	.978**	1.000	.246	-.191	-.178
	Age Control Group	-.050	.233	.246	1.000	.127	.086
	Pre Control Group	.069	-.147	-.191	.127	1.000	.890**
	Post Control Group	.028	-.096	-.178	.086	.890**	1.000

\*\* Correlation is significant at the 0.01 level (2-tailed).

**Graph 1:** Comparison between uEFI experimental and control group

Sub items of the abilities to perform the activities were compared between the two groups via UEFI. The correlations of upper extremity functional index pre and post score of experimental and controlled group were shown in [Table 3].

[Graph 1] showed the comparison between the UEFI of experimental and control group in which there is significant improvement in UEFI (pre and post) of experimental group before and after training session.

The upper extremity motor functions were significantly improved after using mirror therapy and thermal stimulation for 4 weeks as compared with the control group.

## Discussion

Mirror therapy and thermal stimulation relatively a new treatment technique developed to promote upper extremity recovery in stroke patients [8].

In the present study, aspect of somatosensory stimulation and mirror illusion of normal movement is taken as a point of reference for treatment in hemiplegic with functional dependence on the basis of UEFI [5,8].

UEFI is a preferred upper limb regional tool due to its superior practical characteristics and clinical utility and comparable psychometric properties [47].

The result of the study confirm that the mirror therapy and thermal stimulation has improved upper limb function as demonstrated with UEFI.

There is a significant change in post intervention in Group A  $p \leq 0.05$  which approves improvement in functional activity according to UEFI. The use of mirror therapy creates the mirror illusion of normal movement of the affected hand may substitute for decreased proprioceptive information, thereby helping to recruit the premotor cortex and assisting rehabilitation through an intimate connection between visual input and premotor areas.



Thermal stimulation promotes upper extremity recovery in stroke patients because TS may induce cortical reorganization. TS not only provides somatosensory stimulation but also uses the forced-use strategy to provoke volitional/reflexive motor activity. It has been proposed that somatosensory stimulation may induce brain plasticity [8].

TS was provided through general hot/cold packs, but it was difficult to provide constant temperature stimulation and avoid tissue damage. The improvement was seen after 4 weeks, but continued improvement was not found and need to be considered as lack of supervision and follow ups.

The control group (Group B) showed non-significant result of  $P > 0.05$ . In this group, conventional physiotherapy was given to the patient, and shows non-significant results after 4 weeks when compared to pre intervention scores. This states that general exercises or conventional physiotherapy in the form of active and active-assisted exercises are not sufficient for speedy and significant outcomes. This result also places stress on proper treatment protocol with proper treatment modalities for patient for expected outcome hence proving experimental hypothesis.

Clinically this study demonstrated that by using mirror therapy and thermal stimulation as a treatment tool, the improvement was seen in upper extremity functional activity of post stroke hemiparetic subjects.

### **Clinical Relevance**

Functional limitation of upper extremity is very common in stroke patients. Various researches have shown effect of physical therapy measures like taping, functional stimulation, PNF etc. in improving functional activity of upper extremity in stroke subjects. Few researches have been published regarding the effectiveness of mirror therapy and thermal stimulation in stroke subjects. This study aims at finding out the effectiveness of mirror therapy and thermal stimulation in combination in improving the functional activity of upper extremity in sub-acute stroke patients. Hence combined treatment by mirror therapy and thermal stimulation should employ in upgrading rehabilitation protocol of hemiplegic subjects.

### *Future Research*

1. Further studies are recommended to minimize these limitations in such a way that larger sample sizes of both the sexes that include various age groups of people are studied.
2. The duration of study can be increased.
3. The inclusion criterion can be improved so that all the subjects show similar functional independence in upper limb at the beginning of the study.
4. Various outcome measures can be used in order to record the functional independence in a better way.
5. Study can also be done to improve lower extremity functions.
6. Study can be done on chronic patients.

### *Limitations of the Study*

1. The duration of study was only 4 weeks, so further prognosis and long term benefits could not be recorded.
2. Home exercises were not prescribed to the subjects.
3. Training depends on functional level of patients.
4. Task specificity and stroke severity are important factors in rehabilitation of upper limb.
5. It is difficult to maintain constant temperature.
6. Thermal stimulation cannot be performed on patients with sensory loss.

### **Conclusion**

Mirror therapy and thermal stimulation was found to be effective in improving functional independence in upper limb post sub-acute stroke. When mirror therapy and thermal stimulation is administered to patients suffering from sub-acute stroke over a period of 4 weeks, it results in an improvement in reaching forwards, grasping, manipulating objects and also improves other fine motor functions of the hand.

### **Summary**

This research was done to find out the combined effect of mirror therapy and thermal stimulation on functional independence of upper limb in sub-acute stroke cases. 30 participants between 45-65

years of age with clinical diagnosis of stroke. Patients were randomly divided into two groups i.e. group A and group B. Each group contain 15 patients and treatment was administered for 6times a week over a period of 4 weeks. The treatment comprises of 30 minutes of mirror therapy and thermal stimulation.

Outcome was measured in terms of UEFI score, to record the functional improvement in the upper limb.

Paired 't' test was done for statistical analysis. Results showed there was significant improvement in functional independence of upper limb, based on pre and post UEFI scores in patients who were administered mirror therapy and thermal stimulation for duration of 4 weeks. On comparing both groups group A shows significant improvement than group B.

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