



# Effects of Mirror Therapy and Constraint Induced Movement Therapy for Functional Enhancement of Post Stroke Patients

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## Abstract:

**Objective:** To study the effects of mirror therapy and constraint induced movement therapy, including functional tasks and daily activities in patients with Sub acute stroke.

**Methods:** Subjects were randomly divided into two groups: the mirror therapy group (n=25) and constraint induced movement therapy group (n=25). For the mirror therapy group received 20 minutes a day for 4 weeks, 5 days a week functional task and constraint induced movement therapy with a shoulder strap on healthy arm 30 minutes functional task. After 4 weeks of treatment, Fugl- Meyer Motor Function Assessment score (FMA), Wolf Motor Function test, Brunnstrom motor recovery stage, and Modified Barthel Index (MBI) were evaluated.

**Result:** After 4 weeks of treatment, in most functional evaluations of upper extremity hemiplegia, the mirror therapy groups and CIMT showed higher improvement ( $p<0.01$ ) then the mirror therapy.

**Conclusion:** The Mirror therapy group showed a higher improvement than the mirror therapy group and the fine motor ability of the hemiplegic upper extremity was also improved in sub-acute stroke patients.

**Keywords:** Mirror Therapy, Constraint –Induced Movement Therapy, Upper Extremity, Activities of Daily Living, Sub acute Stroke

## Abbreviations:

CIMT: Constrained- induced Movement Therapy

MT: Mirror therapy

FMA: Fugl-Meyer Motor Assessment

MBI: Modified Barthel Index

WFT: Wolf Motor Function Test

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### **Introduction**

Stroke (cerebrovascular accident [CVA]) is the sudden loss of nerve function caused by the interruption of blood flow to the brain. Ischemic stroke is the most common type, affecting about 80% of stroke victims and can result from thrombosis, embolism or hypo perfusion.. Stroke is the fifth leading cause of death in adults in the United States and the leading cause of long term disability. The incidence of stroke death exceeds 133,000 annually, with stroke accounting for 1 in 20 deaths in the United States. It has been reported that up to 85% of stroke survivors develop hemiplegia and 55% to 75% of stroke survivors have upper limb dysfunction<sup>1</sup>. To assess the effectiveness of various rehabilitation methods for improving upper limb motor control such as exercise training of the paretic arm<sup>2</sup> impairment-training of the upper arm<sup>3</sup> functional electrical stimulation<sup>4</sup> robotic assisted rehabilitation<sup>5</sup> and bilateral arm training<sup>6</sup>.

Ramachandran and Roger Slamachandran<sup>7</sup> first introduced the use if these optical illusions produced by mirror treatment of phantom limb pain. By overlaying the phantom limb pain on the intact arm using specular reflexes, patient often felt relaxed by moving the cramped phantom limb and reported relieving pain<sup>8</sup>. Since its first report, the successful use of mirror therapy in patients with other pain syndromes, such as complex pain regional syndrome, has been reported<sup>9</sup>. Altschuler et.al<sup>10</sup> proposed a new therapeutic drug. An intervention called mirror therapy that focuses on the movement of the contralateral limbs. In mirror treatment, unaffected limb movement are performed while observing reflection in a mirror placed so that an image of the contralateral limb is superimposed on the affected limb, and the affected limb is affected. Produced visual effect and creates a visual illusion with improved mobility of affected limb<sup>11</sup>. Studies of the effects of mirror therapy on the upper limb have shown improved range of motion in patients with chronic stroke, improved speed and accuracy of exercises, increased compression, and improved motor function and recovery<sup>12</sup>.

Forced exercises therapy (CIMT) is a promising therapy for forcing stroke patients to use the affected limb<sup>13</sup>. CIMT was introduced in stroke patients because it is clear that they could not teach compensatory skills without damaging the hemiplegic arm while using ADL<sup>14</sup>. The CIMT principle is based on previous studies on monkey in which the somatosensory sensation of a single upper limb was surgically removed by dorsal rhizotomy<sup>15</sup>. Experimental evidence has shown that loss of motor function as a result of afferent blockage is the result of learned disuse<sup>16</sup>. Learned non- use of affected arms is also seen in stroke patients<sup>17</sup>. Although CIMT has been shown to be an effective intervention, Modified CIMT (mCIMT) to book mass training for affected arms without physically limiting the intact arm. Developed and used in stroke patients. This study was designed to assess the effectiveness of this modified form of CIMT.

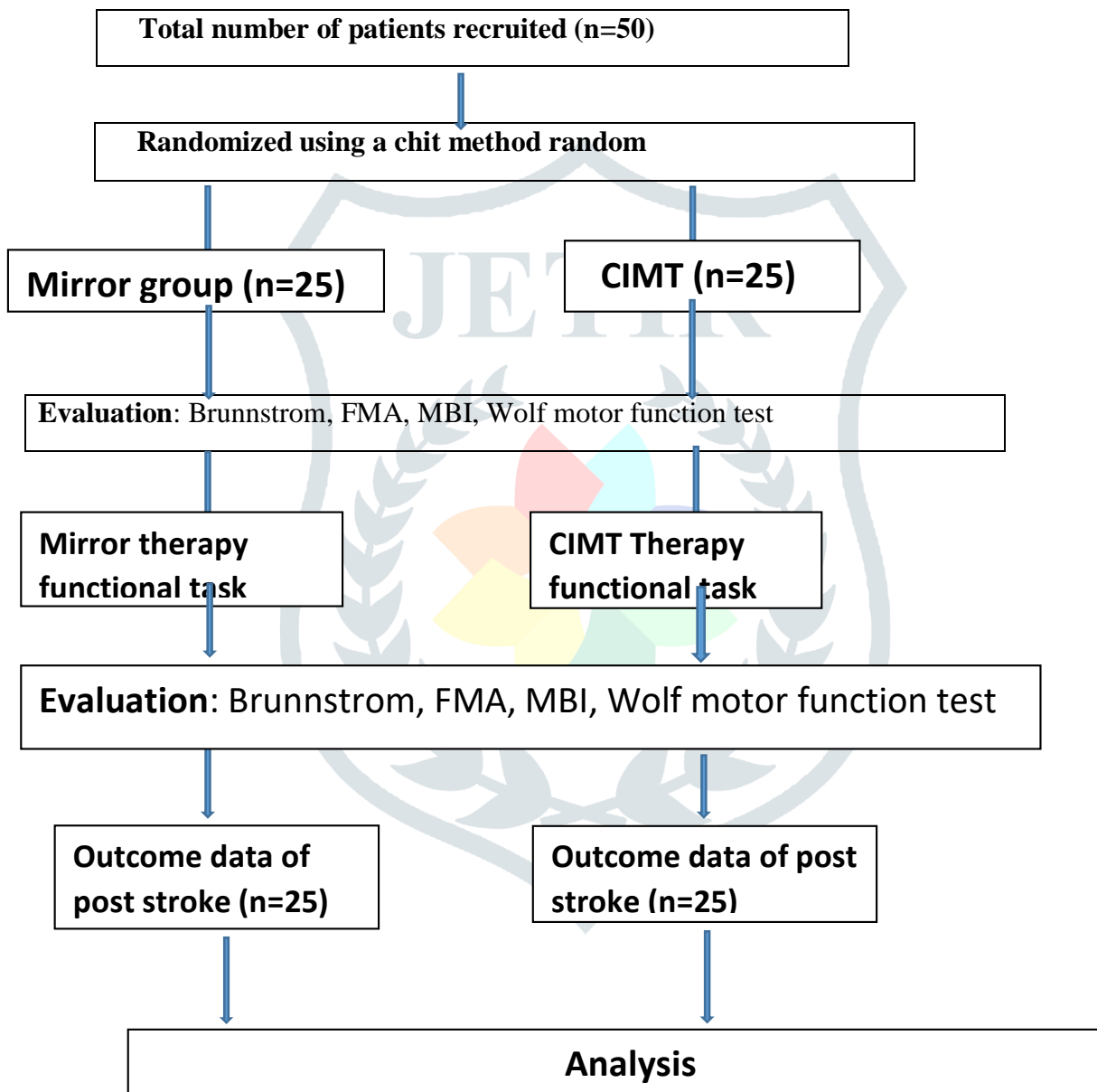
### **Material and Methods:**

The subjects of this study were 50 post- stroke hemiplegic patients with upper extremity defect who were admitted to the rehabilitation department of Vinayak Hospital Noida sec.18. The study was approved by the Ethics Committee of the Noida faculty of Amity University and listed in the Clinicaltrial.gov (CTRI/2022/02/040496). The inclusion criteria were (1) diagnosis of patients under 6 month and they were no past history of stroke,(2) score or more 24 in mini mental status examination (3) Brunnstrom stage of upper extremity recovery 3 to 4 (4) patients is mentally stable and follow the commands and cooperate(5) patients who can maintain a sitting position for more than 30 minutes (6) patients who can perform an active extension of the affected wrist and more than two fingers at an angle of >10 degree and an active abduction of the affected thumb at an angle of > 10 degree. The exclusion criteria were (1) Age not less than 40 and more than 55 years.(2) patients not able to cooperate and follow the commands,(3) Musculoskeletal disease,(4) Mental illness (5) patients who have complex regional pain syndrome or secondary adhesive capsulitis.

**Methods:**

Subjects were randomly assigned to the mirror therapy group and constraint induced movement therapy group using randomization chit. All patients completed the study, mirror therapy group received mirror group with both hands for 20 minutes, and the constraint induced movement therapy group received CIMT with functional task for 30 minutes. The intervention was performed five times per week for 4 week. A clinician performed the intervention before and after the 4<sup>th</sup> week of intervention.

Method are outlined by flow chart below:

**Mirror therapy:**

Patients underwent work-focused mirror therapy for 20 minutes by first showing the upper extremity in the mirror, the patients attempted to move the hemiplegic upper extremity in the same way as the normal extremity that appears in the mirror under the supervision of a therapist, who helped patients concentrate on their movements. Beginning from a neutral position, patients were asked to re-enter movement 20 times for each set of three sets, with a 2<sup>nd</sup> interval between sets. There were also minute intervals between each completed task.

1 Week	Simple movement	Look at his hand reflected in the mirror Forearm pronation and supination Wrist flexion and extension
2 weeks	Simple movement	Finger flexion and extension Counting/opposition/taping
3 weeks	Simple task	Pick up a coin or bean Flip a card
4 weeks	Complex task	Put block into bucket Placing peg on a board Copying shapes on a paper Color in a drawing with crayons

**Table 1:** mirror therapy and CIMT therapy containing functional task

### **Constraint –induced movement therapy:**

The constraint induced movement therapy group performed the same functional tasks at the same period, that is upper extremity hemiplegic patients began normal hand under the supervision of the therapist, yet the unaffected hand strap a shoulder sling and hemiplegic upper extremity perform 30 minutes functional tasks.

### **Tools:**

All patients are placed near a hospital desk. Patients in the mirror therapy group were able to see the reflection of the normal upper limb with a vertically mirror, 35\*35cm. In the constraint induced movement therapy group they strap shoulder sling of normal hand.

### **Measurement tools:**

Fugl –Meyer Motor function Assessment (FMA) and Brunnstrom stage were used to estimate the hemiplegic upper extremity function, and daily life activities using the revised Modified Barthel Index (MBI), and Upper Extremity wolf motor function test evaluated.

### **Analyses:**

Statistically analyzed of all data was performed using SPS ver.19.0 for windows (IBM). The independent sample t-test were performed to assess the general characteristics of the mirror therapy and constrained induced movement therapy group, and prior to the intervention these two groups had capabilities for daily living activities and the the hemiplegic function of upper extremity. 2 tailed t-test was performed to compare the brunnstrom stage of the hemiplegic upper extremity of the hand. A paired comparison t-test was used to assess the changes in daily life activities before and after the intervention and abilities in hemiplegic upper hand function. An independent t-test is evaluated which convert the two group.

### **Results:**

#### **Subject's general characteristics**

Fifty patients were divided into mirror therapy and constraint induced movement therapy (25 in each group). The two group consisted of 16 males and 9 females. Patients in mirror therapy average 45 years and 53 years in constraint induced movement therapy group and in mirror therapy group compared with 10 right side hemiplegia and 15 left side hemiplegia another group that is constrained induced movement therapy there were 9 right side hemiplegia and 16 left side hemiplegia. We also compare the degree of the functions of the upper extremity and the performance of daily activities before and after the treatment in each group. The baseline assessment had no statistically significant difference between the groups. All parameters in the CIMT and MT and showed that MT has significant improvement then CIMT.

**Brunnstrom stage:**

The brunnstrom phase of the mirror therapy group and CIMT before and after treatment of the upper hemiplegic extremity made a significant difference of  $3.52 \pm 4.04$  ( $P < 0.01$ ) in mirror treatment and  $3.44 \pm 4.16$ .

**FMA:**

Functional changes in the hemiplegic upper limb between anterior and post- intervention. The FMA score increased significantly from  $70.28 \pm 80.6$  ( $P < 0.01$ ) in the mirror therapy group and  $70.08 \pm 76.36$  ( $P < 0.01$ ) in the CIMT group. Consequently, both groups exhibited significant functional development of the hemiplegic upper limb post- therapy. The degree of recovery was higher in the mirror therapy than in the CIMT group.

**MBI:**

Performance was assessed in daily life activities between pre and post- intervention using the MBI. There were significant increase in two groups:  $53 \pm 67.2$  ( $P < 0.01$ ) in the mirror therapy group and  $54.92 \pm 65.2$  ( $P < 0.01$ ). The degree of recovery was higher in mirror therapy than the CIMT.

**WFT:**

The wolf motor function upper extremity test has 17 component taken before and after intervention where mirror therapy is showed greater significant than the CIMT ( $P < 0.01$ ).

**Table 2: comparison of MBI in both group**

variable	mean	Std.deviation	Std.error	Lower95 CL	Upper 95 % CL	N
%inc MBI GP2	20.888	14.294	2.859	14.488	26.288	25
% inc MBI GP1	27.759	9.027	1.805	24.033	31.485	25

2 tailed t-test

Ho.diff	Mean diff	SE diff	T	DF	P
	7.371	3.881	2.180	48.000	0.035

SIGNIFICANT "P" &lt; 0.05

Variable                      Mean

%Inc MBI GP2                      20.3888                      % Inc MBI is greater

% Inc MBI GP1                      27.759

**Table 3: comparison of FMS in both the group**

variable	mean	Std.deviation	Std.error	Lower95%CL	Upper 95%CL	N
%incFMS GP2	9.316	4.659	0.932	7.393	11.239	25
%incFMS GP1	15.103	5.821	1.164	12.701	17.506	25

2tailed t-test

Ho.diff	Mean diff	SE. diff	T	DF	P
	5.787	1.491	3.881	48.000	0.000

Significant "P" &lt; 0.01

Variable	Mean	
% Inc FMS GP2	9.316	% Inc FMS GP1 greater
% Inc FMS GP1	15.103	

**Table 4: Comparison of Brunnstrom stage in both the group**

Variable	mean	Std.deviation	Std.error	Lower95%CL	Upper95%CL	N
%inc B GP2	20.000	14.410	2.882	16.052	27.948	25
% inc B GP1	15.333	15.343	3.069	9.000	21.667	25

2 tailed t –test

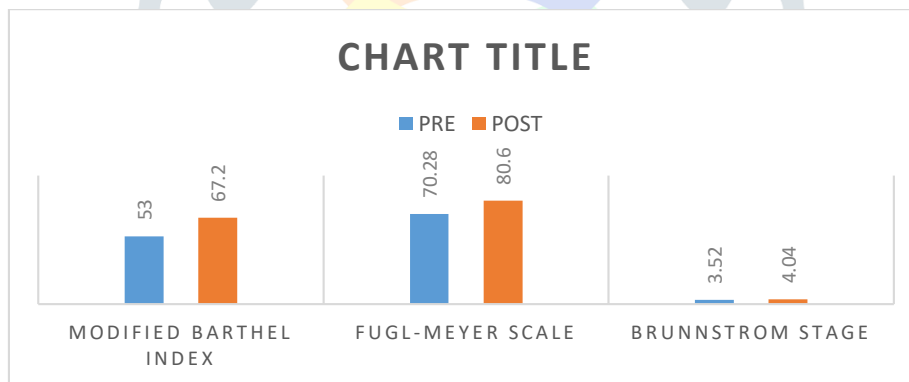
Ho.diff	Mean diff	SE.DIFF	T	DF	P
0.000	6.667	4.210	1.584	48.000	0.120

Not Significant “P” >0.05

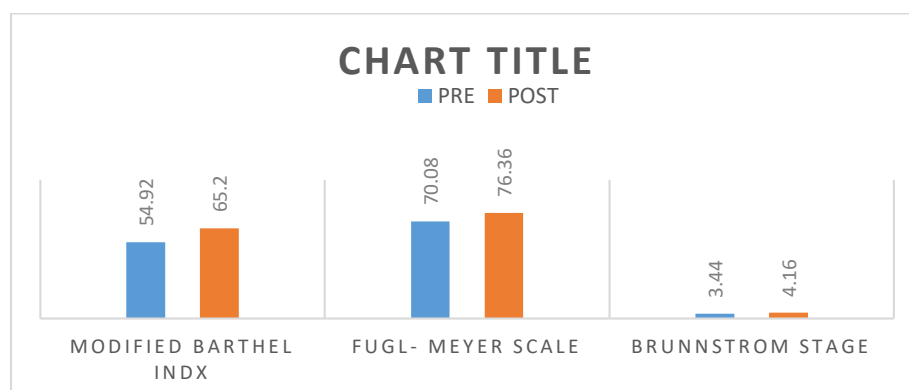
Variable	Mean
% Inc B stage GP2	22.000
% Inc B stage GP1	15.333

Mean percentage in the 2 groups not significant and % increase is almost similar in the 2 groups.

**Graph representation of MBI (a), FMS (B), Brunnstrom Stage PRE and POST intervention in mirror therapy:**



**Graph representation of MBI (A), FMS (B) AND Brunnstrom stage IN PRE AND POST intervention of CIMT:**





**Discussion:**

The stroke is one of the main cause that can cause disability<sup>18</sup>. Impaired muscle strength after a stroke is a therapeutic challenge for patients, caregivers, and rehabilitation therapist<sup>19</sup>. In particular, the phenomenon of disuse in the affected upper limb is characterized by a tendency to use the less affected upper limb to normally perform functional tasks<sup>20</sup>. These intensive rehabilitation treatments for the upper extremity training may be based on the structural plasticity experienced by gray and white matter after the onset of stroke<sup>21</sup>. It is shown that there is an increase in the activity of the area of the main motor cortex corresponding to the contralateral hand above the mirror<sup>22</sup>. In this study, the patients with hemiplegic stroke with upper extremity involvement were included. Further, they divided into two groups one group was given constraint induced movement therapy and another group as mirror therapy. The treatment was given 4 weeks and after that the patient with mirror therapy and cimt. Both groups showed good improvement, but more improvement showed in the mirror therapy group when compare to the constrained induced movement therapy. Based on the result, the mirror therapy group showed a significant improvement in hand function and to perform activities of daily living compared to the mirror therapy. As a result of the patient engaging in repetitive exercises with the affected limb, the brain grows develops a new neural pathway.

**Conflict of interest:**

No potential conflicts of interest related to this article have been reported.

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