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Compare The Effectiveness of Modified Constraint Induced Movement Therapy (mCIMT) and Mirror Therapy (MT) in Stroke Patients Based on Severity

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Abstract

Introduction: Stork is a global epidemic and an important cause of morbidity and mortality. As defined by WHO stroke is "rapidly developing clinical sings of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, no apparent cause other that of vascular origin."[1] Stroke due to cerebral infarction, primary intracerebral hemorrhage (PICH), intraventricular hemorrhage, and most cases of subarachnoid hemorrhage (SAH); it excludes subdural hemorrhage, epidural hemorrhage, or intracerebral hemorrhage (ICH) or infarction caused by infection or tumour.[2,3] *Aim of the Study:* Compare the effectiveness of mCIMT and Mirror Therapy (MT) on upper extremity and hand functions among individuals with stroke based on the severity as assessed by the UEFM and ARAT. *Methods:* It is an experimental study design. Sample of convenience of twelve (12) stroke subjects are selected and divided into group A and group B. Group A received Modified Constraint Induced Movement Therapy (mCIMT) and group B received Mirror Therapy in upper extremity and hand functions in stroke patients. *Discussion:* In our study Modified Constraint Induced Movement Therapy (mCIMT) is more effective than Mirror Therapy (MT) in upper extremity and hand functions in stroke patients. Joachim Liepert et al., 2000. The mechanism of this massive cortical reorganization probably reflects eitheran increase in the excitability of neurons already involved in the innervation of more-affected hand movements or an increase in excitable neuronal tissue in the infracted hemisphere, or both.[26] *Conclusion:* This study concluded that Modified Constraint Induced Movement Therapy (mCIMT) is more effective than Mirror Therapy (MT) in upper extremity and hand functions in stroke patients. In this study the patients from mild to moderate and moderate to severe post stroke disability improved better in stroke patients. So hypothesis is accepted that mCIMT is more effective than Mirror Therapy (MT) in from mild to moderate and moderate to severe post stroke disability.

Keywords: mCIMT, Mirror therapy (MT) UEFM, ARAT. (VAS) visual analog scale, Fugl-Meyer Assessment scale and Action research arm test (ARAT) scores

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Introduction

Stork is a global epidemic and an important cause of morbidity and mortality. As defined by WHO stroke is "rapidly developing clinical sings of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, no apparent cause other that of vascular origin."[1]

Strokes can be classified into two major categories: ischemic and hemorrhagic. Ischemic strokes are caused by interruption of the blood supply, while hemorrhagic strokes result from the

rupture of a blood vessel or an abnormal vascular structure. About 87% of strokes are ischemic, the rest are hemorrhagic.[2,3]

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. Stroke is a global health problem. It is the second commonest cause of death and fourth leading cause of disability worldwide (Strong 2007).[4]

Stroke is one of the main health problems in the Western world (Roger et al., 2011). Because about 80% of the survivors have an upper limb paresis immediately after stroke onset (Nakayama et al., 1994).[6] A wide range of interventions have been developed to improve upper limb function (Langhorne et al., 2009).[5]

Approximately 20 million people each year will suffer from stroke and of these 5 million will not survive (Dalal 2007).[6] In developed countries, stroke is the first leading cause for disability, second leading cause of dementia and third leading cause of death.

Stroke is a leading cause of functional impairment, with 20% of survivors requiring institutional care after 3 months and 15% - 30% being permanently disabled (Steinwachs 2000).[7]

Stroke is a life-changing event that affects not only the person who may be disabled, but their family and caregivers. Utility analyses show that a major stroke is viewed by more than half of those at risk as being worse than death (AHA 2006). Organized provision of care in a stroke unit have been found to increase the number of patients who survive, return home, and regain functional independence in their everyday activities (Stroke Unit Trial lists Collaboration 1997).[8]

However implementation of such organized care for stroke is limited and inadequate in low and middle income countries, especially in a country like India where resources for rehabilitation are scarce (Peter Langhorne 2012).[9]

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 malalignment.[10]

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.[11.]

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. In many patients with severe stroke, the affected upper limp (UL) never becomes useful, even after therapy. Only about 15 percent of those suffering from severe stroke recover hand function.[12 &13]

Constraint-induced movement therapy is a form of rehabilitation therapy that improves upper extremity function in strokeand other Central nervous system damage victims by increasing the use of their affected upper limb.[14]

CIMT (constraint induced movement therapy) by Taub, CIMT is a neurorehabilitation approach developed by behavioral neuroscientist Dr. Edward Taub and colleagues.[15]

Modified CIMT (mCIMT) - It was developed later, when use of CIMT clinically was not up to the mark or its application was laborious and time consuming. There were many different alternative modified forms of CIMT were made by deferent researchers.

There are limited evidence suggesting the influence of mCIMT in improvement of upper extremity and hand functions post stroke based on the severity of lesion.[16]

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.[17]

Review of Literature

Sudha Dhami, (2019) Mirror therapy and repetitive facilitation was found to be effective in improving functional independence in upper limb post sub – acute stroke. When mirror therapy and repetitive is administer 3rd to patient 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 others motor functions of the hand.[1]

Shama Praveen, (2018) et al. conducted study onMirror Therapy and Thermal Stimulation on upper extremity motor functions in post stroke hemiparetic subjects. 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.[4]

Langhorne P and Bernhardt J et al, (2009) concluded cerebrovascular accident (CVA) or brain attack is a sudden loss of brain function due to a disturbance in the blood supply to the brain. The World Health Organization defined stroke (introduced in 1970 and still used) is "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin."[5]

Rinske Nijland et al. (2013) characterizing the Protocol for Early Modified Constraint-induced Movement Therapy in the EXPLICIT-Stroke Trial explained that the purpose of the present paper is therefore to describe the essential elements of the mCIMT protocol as developed for the Explaining plasticity after stroke (EXPLICIT-stroke) study.[23]

Yue X Shi er al. (2012) They concluded afairly strong evidence that modified CIMT could reduce the level of disability, improve the ability to use the paretic upper extremity, and enhance spontaneity during movement time, but evidence is still limited about the effectiveness of modified CIMT in kinematic analysis.[24]

Joachim Liepert et al. (2000) concluded that this is the first demonstration in humans of a long-term alteration in brain function associated with a therapy-induced improvement in the rehabilitation of movement after neurological injury.[26]

Kristina Laaksonen (2012) concluded that MEG (magnetoencephalography) provides a suitable tool to study cortical neuro-physiological alterations after stroke. We observed a variety of alterations which seem to be significantly related to clinical recovery. In the future, studies with more severe stroke patients and longer follow-up times as well as interventional studies may lead to an improvement of individually designed and well-targeted rehabilitation to maximize the recovery potential after stroke.[27]

VW Mark, E Taub and DM Morris (2006) concluded that in short we now understand that the mature brain is not physiologically stagnant either in health or non-progressive disease. Significant plastic brain reorganization can occur within hours of environmental or somatic changes that affect sensory input and such change may be adoptive or mal adoptive.[28]

Nishu Sharma, (2018) done study on Intermittent Pneumatic Compression and Mirror Therapy Improve Hand Functions after Stroke. The study concluded that hand functions improved by Intermittent Pneumatic Compression and Mirror Therapy in sub-acute stroke subjects and interventions should be emphasize to restore motor and sensory function.[29]

Holm Thieme et al. (2013) did study on "Mirror therapy for improving motor function after stroke". Concluded that the MT could be applied at least as an additional intervention in the rehabilitation of patients after stroke.[30]

Archana Chauhan, (2018) This study concluded that there is significant improvement in functional activity of upper extremity in hemiplegic subjects after kinesiotaping. On comparing group A and group B the results were significant in group A and there is not significant improvement was seen in group B when some components of taping were missed.[31]

Niranjan Kumar, (2019) This study concluded that the patients from moderate to severe post-stroke disability improved better than the mild sever stroke patients so in this case the hypothesis can be rejected and it is accepted that CIMT can be used more beneficially in moderate and severe disability post-stroke than the mild post-stroke disability.[32]

Materials and Methods

A twelve (12) patents were selected for this study on the basis of randomization selection criteria. The study was doneat Neuro-Medicine Department, Arunabh NGO, Indore were diagnosed with Stroke/Cerebrovascular Accident (CVA) were chosen purposively selected as subjects for the study. 12 stroke patients constituted the study group and were willing to take treatment for 3 week sessions.

The subjects/attendants had explained about the complete study procedure and information about constraint induced movement (CIMT) technique the study had recorded in a consent form dually signed by him. The study was approved by NGO ethical review board (IRB). The study elements had analyzed for Fugl-Meyer Assessment scale and Action research arm test (ARAT) scores in order to compare the effectiveness of and Mirror Therapy (MT) and the significance of mean differences

between pre-intervention and after intervention stroke patients.

Convenient sampling- Patients diagnosed with CVA from neuro medicine department was included in study based on inclusion criteria and exclusion criteria.

Inclusion criteria- First episode of stroke, Stroke experienced more than 1 months and less than 6 months prior to study enrollment, Ability to actively extend up to 20 degrees at the wrist as assessed by manual goniometer, A score 24 or more on (MMSE) Mini Mental Status Examination, Age 40 to 60 years, Modified Ashworth spasticity (MAS) Scale 2 or less than 2 in affected upper extremity of 6 muscles (shoulder abductors, elbow flexors & extensors, wrist flexors & extensors, finger flexors & extensors and thumb flexors).

Exclusion criteria- Rigidity of the affected upper extremity, Excessive pain in the more affected arm, as measured by a score of ≥ 4 on a 10 point (VAS) visual analog scale, Currently participating in any experimental rehabilitation or drug studies (mainly on muscle relaxants and on pain killers) and Patients having sensory impairment of hand. Outcome measures- (UEFM) Upper extremity Fugl-Meyer and (ARAT) Action research arm test & Goniometer.

Procedure

Patient's sensory integrity was assessed with touch of cotton ball, prick & hot and cold test tubes on dorsum of hand and fore arm. There after the ability of wrist to extend at least up to 20 degree was assessed by goniometer. A steel half circle (180˚) universal goniometer was used with fulcrum over lateral aspect of wrist over triquetrum, proximal arm over lateral to mid line of ulna and distal arm lateral to mid line of 5th metacarpal bone.

In ARAT patients were given a series of objects in hand to assess hand abilities such as grasp, grip, pinch & gross movements. The patients were given 3 or 0 scores for each the correct or incorrect action performed during test. This test had four sub tests having different totals with grand total of 57 and thus scores were given out of 57.

Patients were categorized into three mild, moderate and severe on both the scales. In UEFM the patients whose final score was between 0-27 considered as sever and score between 28-49 considered as moderate and score between 50-60 was considered as mild.

In ARAT the categorization was slightly different than fugl-mayer as here the percentage difference between more affected and less affected hand was taken to denote severity grading. The grand total of 57 was considered as 100% and the final percentage difference was calculated through subtracting the percentage of more affected arm from the less affected arm.

Formula:

{percentage of less affected arm – percentage of more affected arm}.

Now the patients were randomized through blocked randomization in three categories 0–30% (as mild) 30–60% (as moderate) and 60–90% (as severe).

There after mCIMT & Mirror Therapy (MT) was given as treatment intervention for stroke patients. The participants were asked to wear padded safety mitt on their less affected hand during treatment and at least 3 hours at home. All subjects were instructed to take the mitt off during certain activities mainly involving coordinated movements of both the hands simultaneously for example, when driving a car or riding a bike or reading a news paper.

Repetitive training and constraining

The mCIMT protocol applied in the EXPLICIT-stroke trial retains two of the three main elements of the original form of mCIMT, that is, the repetitive training and the constraining element, and is applied for 15 consecutive week days.

Repetitive training

Patients receive 1 hour of individual training on each working day during a 3-week period, starting 1 month after stroke. Depending on the patient's ability to sustain training, the hour can be divided into two 30-minute or four 15-minute sessions per

Fig. 1: mCIMT protocol, repetitive training practice

working day.

In line with the original mCIMT protocol, repetitive training consists of 'shaping' and 'task practice'. (Rinske Nijland et al., 2012) (Fig. 1).

(a) Shaping: During each session, shaping principles play a dominant role. Shaping is defined as a training method in which a motor objective is approached in small steps by successive approximations (Morris et al., 2006). For instance, the task difficulty can be incrementally increased in accordance with a patient's capabilities, or the requirements for speed performance can be progressively augmented (Morris et al., 2006).

The main objective is to encourage the patient to use the more affected upper limb repeatedly to overcome (or prevent) learned non-use and to induce activity-dependent cortical reorganization (Morris et al., 2006).

Shaping is mainly applied at levels 1 and 2 of the treatment matrix.

(b) Task practice: Task practice is a less structured way of training than shaping. Task practice is defined as a training method in which functional tasks are practiced. It is implemented mainly at level 3 of the matrix, when a patient has successfully completed levels 1 and 2 and is able to integrate the improved control of the extensors in functional unilateral tasks (i.e. eating, cutting bread, cleaning a table, ironing or writing).(Rinske Nijland et al., 2012).

Constraining

In the EXPLICIT-stroke program, patients wear a padded safety mitt on the less affected hand during each training session, and for at least 3 hours per day, they were forced to use the more affected limb only. The mitt restricts the ability to use the less affected hand during most tasks, while still allowing protective extension in the elbow in case of imbalance. Patients receive homework at the end of each training session, according to the treatment aims, to encourage them to exercise the more affected limb during the 3 hours when the mitt is worn outside therapy sessions. The homework is discussed and evaluated at the beginning of the next therapy session. (Rinske Nijland et al., 2012). (Fig. 2).

Patients are given homework, and patients also have to keep a diary, to encourage them to take the mitt practice seriously. The patient diary is filled in daily and checked by the therapist. The times dedicated to shaping and task practice during the training session, as well as the level and aim that the patient is working on, are documented by patient and therapist. In addition, the times when the mitt is put on and taken off have to be specified in the diary. The information recorded in the patient diary is useful as motivational feedback to the patient by

Mirror Therapy (MT)

In Mirror Therapy (MT) the patient is standing close

Fig. 2: Constraining training session of affected hand

Fig. 3a & b: Showing patient doing exercises in mirror

to a mirror was placed side of the patient (affected side) as shown in Figure 3 (a,b). The involved hand is placed behind 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 for 6 days per week for a consecutive 4 weeks.

Statistical Technique

The raw data were entered into the computer database. The responses of frequencies were calculated and analyzed by using the raw data of 12 subjects. Prevalence of an outcome variable along with 95% confidence limits was calculated. Statistical software, SPSS version 17.0 was used for analysis.

A parametric test, unpaired t-test was used to compare the effectiveness between mCIMT therapy and Mirror Therapy (MT) of upper extremities Fugl-Meyr and ARAT at pre-intervention and post-intervention in stroke patients.

Paired *t*-test was used to identify the significance of difference in motor recovery in upper extremities score and percentage from ARAT between pre-intervention and post-intervention and handedness in left and right side of arm in stroke patients. The probability value, $p > 0.05$ was considered as statistically insignificant .

Table 1: The UEFM assessment of Constraint Induced Movement Therapy (CIMT) at pre and post interventions

Upper extremity Fugl-Meyer score	Pre Intervention		Post Intervention	
	N	%	N	%
0-27 (Severe)	*11*	*91.7*	*3*	*25.0*
28-49 (Moderate)	*1*	*8.3*	*9*	*75.0*
50-60 (Mild)	*0*	*0.0*	*0*	*0.0*
Total	*12*	*100.0*	*12*	*100.0*

Results

A total of 12 cases of stroke treated as study elements that constituted study group (n = 12) were purposively selected as subjects for the present study. Out of 12 subjects, 9 (75.0%) were male while rest 3 (25.0%) were female. The age of all subjects were obtained in the ranges from 40 to 70 years. The spread of mean age in subjects with stroke were identified in the ranges of 56.00 ± 9.27 years. The following tables are showing the analyzed results with interpretations.

Table 1 & Figure 4 projected the stroke patients had improved functions after administration of Constraint Induced Movement Therapy (CIMT) as the severity of stroke had reduced, easily seen by the increased score obtained after intervention.

Major proportion of subjects 11 (91.7%) found with severe stroke while only 1 (8.3%) patient had moderate type severity of stroke at pre intervention stage.

After administration of Constraint Induced Movement Therapy (CIMT) most of the subjects

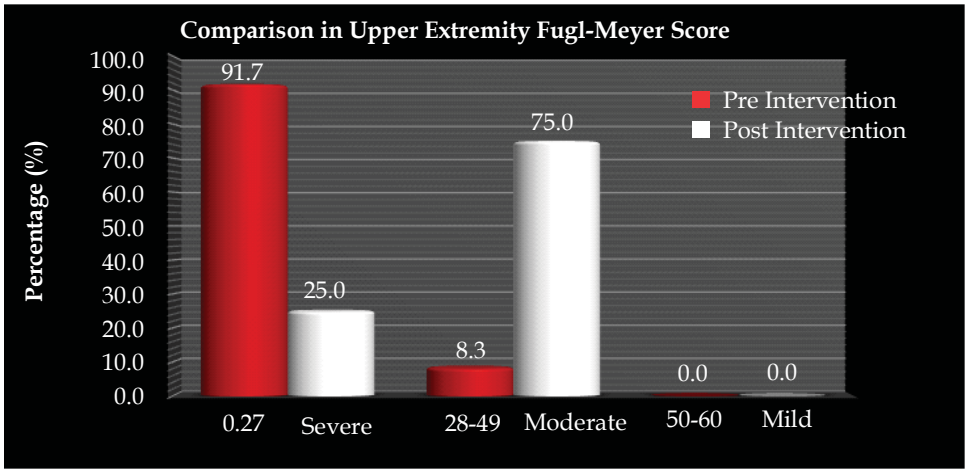

Fig. 4: Multiple Bar diagram depicting the comparison in Upper Extremity Fugl-Meyer score between Pre and Post Interventions of Constraint Induced Movement Therapy (CIMT) among stroke patients

found with reduction in severity of stroke as three-fourth 9 (75.0%) subjects detected with moderate type of stroke while rest one-fourth 9 (25.0%) were left in severe category of stroke.

Henceforth, it is inference that after intervention subjects had improved the functions of affected arm based on severity of stroke that impacted the effectiveness of Constraint Induced Movement Therapy (CIMT) among stroke patients.

Table 2: The UEFM assessment of Mirror Therapy (MT) at pre and post interventions

Upper extremity Fugl-Meyer score	Pre Intervention		Post Intervention	
	N	%	N	%
0-27 (Severe)	11	85.7	3	21.0
28-49 (Moderate)	1	14.3	9	79.0
50-60 (Mild)	0	0.0	0	0.0
Total	12	100.0	12	100.0

Table 2 & Figure 5 projected the stroke patients had improved functions after administration of Mirror Therapy (MT) as the severity of stroke had reduced, easily seen by the increased score obtained after intervention.

Major proportion of sub jects 11 (79.7%) found with severe stroke while only 1 (14.3%) patient had moderate type severity of stroke at pre intervention stage.

After administration of Mirror Therapy (MT) therapy most of the subjects found with reduction in severity of stroke as three-fourth 9 (79.0%) subjects detected with moderate type of stroke while rest one-fourth 9 (21.0%) were left in severe category of stroke.

Henceforth, it is inference that after intervention subjects had improved the functions of affected arm based on severity of stroke that impacted the effectiveness of Mirror Therapy (MT) among stroke patients.

Table 3 and Figure 6 focused on the percentage (%) of test allocated to stroke patients had improved functions after administration of Constraint Induced Movement Therapy (CIMT) as the percentage (%) measured by ARAT was reduced after intervention.

Major proportion of subjects 5 (41.7%) diagnosed with moderate to severe dysfunction shown by percent recorded by Action Research Arm Test (ARAT) while only 2 (16.7%) patient had mild severity of stroke at pre intervention stage.

After administration of CIMT therapy most of the subjects found with decreased percentage recorded on ARAT showed reduction in severity of stroke as two-third 8 (66.7%) subjects detected with moderate type of severity while rest one-third 4 (33.3%) were measured in mild severity of stroke.

Henceforth, it is inference that after intervention subjects had improved the functions of affected

Table 3: The ARAT Percentage of Constraint Induced Movement Therapy (CIMT) at pre intervention and post intervention

Action Research (%) Arm Test Score	Pre Intervention		Post Intervention	
	N	%	N	%
(Mild) 0-30	2	16.7	4	33.3
(Moderate) 30-60	5	41.7	8	66.7
(Severe) 60-90	5	41.7	0	0.0
Total	12	100.0	12	100.0

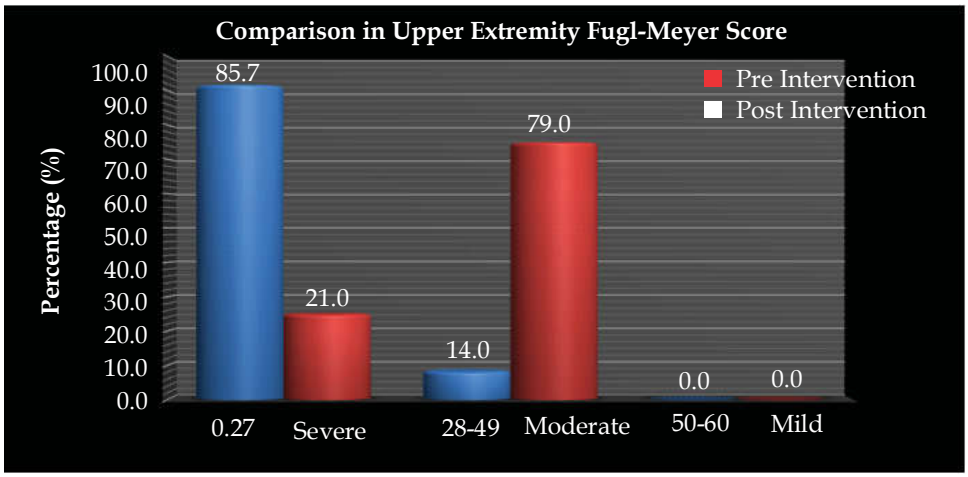

Fig. 5: Multiple Bar diagram depicting the comparison in Upper Extremity Fugl-Meyer score between Pre and Post Interventions Mirror Therapy (MT) among stroke patients

arm based on severity of stroke that impacted the effectiveness of CIMT therapy among stroke patients.

Table 4: The ARAT Percentage of Mirror Therapy (MT) at pre intervention and post intervention

Action Research Arm Test Score (%)	Pre Intervention		Post Intervention	
	N	%	N	%
0-30 (Mild)	2	16.7	4	33.3
30-60 (Moderate)	**5**	41.7	8	66.7
60-90 (Severe)	**5**	41.7	0	0.0
Total	**12**	100.0	12	100.0

Table 4 and Figure 7 focused on the percentage (%) of test allocated to stroke patients had improved functions after administration of Mirror Therapy (MT) as the percentage (%) measured by ARAT was reduced after intervention.

Major proportion of subjects 5 (35.7%) diagnosed with moderate to severe dysfunction shown by percent recorded by Action Research Arm Test (ARAT) while only 2 (21.7%) patient had mild severity of stroke at pre intervention stage.

After administration of Mirror Therapy (MT) most of the subjects found with decreased percentage recorded on ARAT showed reduction in severity of stroke as two-third 8 (56.7%) subjects

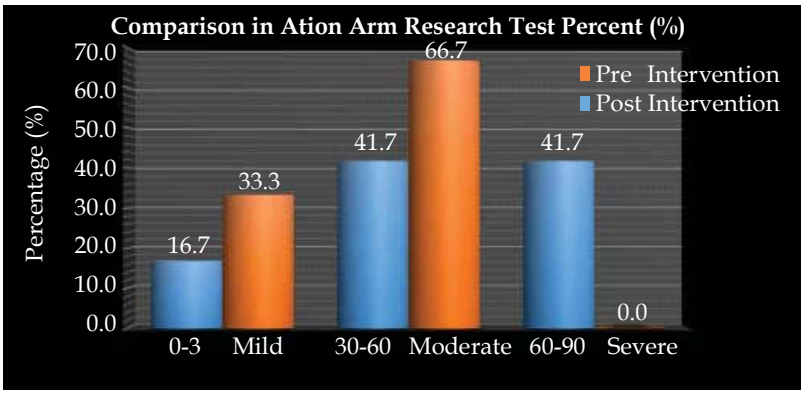

Fig. 6: Multiple Bar diagram depicting the comparison inAction research arm test (ARAT) percentage between Pre and Post Interventions of Constraint Induced Movement Therapy (CIMT) among stroke patients

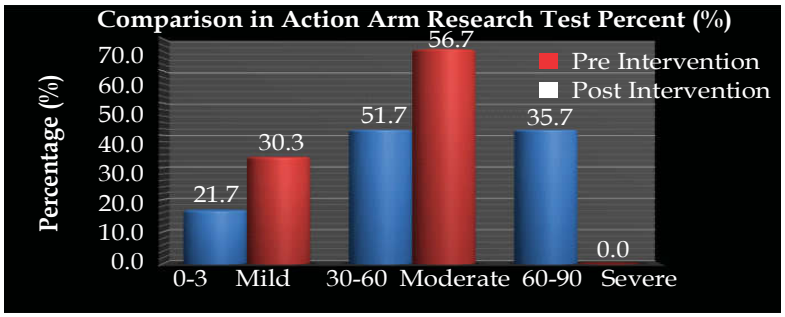

Fig. 7: Multiple Bar diagram depicting the comparison in Action research arm test (ARAT) percentage between Pre and Post Interventions of Mirror Therapy (MT) among stroke patients

Table 5: The Comparison in mean difference between pre & post intervention in UEFM (score) and ARAT (percentage)

Hand -Ness	Parameter/test	Side of lesion	Spread Mean±SD	MD	t-value	LOS
Right (n=10)	Upper Extremity Fugl-Meyer (Score)	Right	20.50±4.01	9.90	11.67	p<0.001#
		Left	30.40±4.65			
	Action Research Arm Test (%)	Right	54.00±16.71	19.60	6.31	p<0.001#
		Left	34.40±16.81			
Left (n=2)	Upper Extremity Fugl-Meyer (Score)	Right	20.00±4.24	6.00	6.00	p>0.05$^{\circledast}$
		Left	26.00±2.83			
	Action Research Arm Test (%)	Right	58.00±29.70	15.50	1.48	p>0.05$^{\circledast}$
		Left	42.50±14.85			

detected with moderate type of severity while rest one-third 4 (30.3%) were measured in mild severity of stroke.

Henceforth, it is inference that after intervention subjects had improved the functions of affected arm based on severity of stroke that impacted the effectiveness of Mirror Therapy (MT) among stroke patients.

The mean difference is highly significant at the 0.001 level of significance. ⊗The mean difference is not significant (insignificant) at the 0.05 level of significance. [Degrees of freedom are 9 and 1; MD-Mean Difference; LOS-Level of Significance]

It was easily seen in the Table 5 that the stroke survivors with right handedness had improved functions after administration of CIMT therapy at right side of lesion had significantly different score and percentage as compared to left side handedness.

The stroke survivors with left handedness hadn't improved functions at right side of lesion and insignificantly different score for upper extremities Fugl-Meyer (UEFM) and percentage for action research arm test (ARAT) when compared with the scores from UEFM and percentage from ARAT at left side of lesion. The stroke survivors with left handedness were only two and may be due to very small sample size the mean difference wasn't significant.

The mean for upper extremity Fugl-Meyer of stroke survivors with right handedness at left side of lesion was 30.40 ± 4.65 points was much higher than right side of lesion was 20.50 ± 4.01 points and the mean difference of 9.90 points between right and left side of lesion was strongly significant ($p < 0.001$) confirmed on statistical ground.

The mean percentage difference of 19.60% among stroke survivors with right handedness between right and left side of lesion in right (54.00 ± 16.71) side was higher as compared to mean percentage for left (34.40 ± 16.81) side of lesion was strongly significant ($p < 0.001$) confirmed statistically.

The mean for upper extremity Fugl-Meyer of stroke survivors with left handedness at left side of lesion was 26.00 ± 2.83 points was higher than right side of lesion was 20.00 ± 4.24 points and the mean difference of 6.60 points between right and left side of lesion was statistically insignificant ($p > 0.05$).

The stroke survivors with left handedness found with mean difference of 15.50% between right and left side of lesion in action research arm test in right (58.00 ± 29.70) side of lesion was much higher as compared to mean percentage for left (42.50 ± 14.85) side of lesion was not statistically significant ($p > 0.05$).

Henceforth, it is statistically concreted that administration of CIMT therapy among stroke survivors with right handedness was beneficial in both the sides of lesion and reported with improved motor functions of affected arm based on severity of stroke that impacted the effectiveness of CIMT therapy among stroke patients.

Discussion

Comparison in mean differences between pre intervention and post intervention in UEFM (score) and ARAT (%). The stroke survivors had improved functions after administration of Constraint Induced Movement Therapy (CIMT) and Mirror Therapy (MT) at post intervention stage and significantly different score for upper extremity Fugl-Meyer (UEFM) and reduced percentage for action research arm test (ARAT) when compared with the scores for UEFM and percentage for ARAT at pre intervention stage. But in our study Constraint Induced Movement Therapy (CIMT) is more effective than Mirror Therapy (MT), so our experimental hypothesis is true.

The mean for upper extremity Fugl-Meyer of stroke survivors at post intervention was higher than pre intervention and the difference (9.25 points) between pre intervention and post intervention was strongly significant at ($p<0.001$) statistical ground.

The percentage (%) of ARAT test allocated to stroke patients had improved functions after administration of CIMT and Mirror Therapy (MT), therapy as the percentage (%) measured by ARAT was reduced after intervention.

Major proportion of subjects 5(41.7% & 51.7) diagnosed with moderate and 5 (41.7% 35.7) with severe dysfunction shown by percent recorded by Action Research Arm Test (ARAT) while only 2 (16.7% & 21.7) patient had mild severity of stroke at pre intervention stage.

After administration of CIMT therapy & Mirror Therapy (MT), most of the subjects found with decreased percentage recorded on ARAT showed reduction in severity of stroke as two-third 8 (66.7% & 56.7) subjects detected with moderate type of severity while rest one-third 4 (33.3% & 30.3) were

measured in mild severity of stroke.

Therefore, it is inference that after intervention subjects had improved the functions of affected arm based on ARAT severity grading of stroke that impacted the effectiveness of CIMT therapy & Mirror Therapy (MT), among stroke patients. But CIMT therapy is more effective than Mirror Therapy (MT).

*T*he Pre Action research arm test % was strongly correlated with post Action research arm test % in positive direction confirmed statistically highly ($p < 0.001$) significant but moderately correlated with post upper extremitiy Fugl Meyer score in negative direction confirmed statistically not ($p > 0.05$) significant.

The Post upper extremity Fugl Meyer score was moderately correlated with post Action research arm test % in negative direction and the relation was confirmed statistically ($p < 0.05$) significant.

The present study "compare the effectiveness of modified constraint induced movement therapy (mCIMT) and Mirror Therapy (MT) in improving upper extremity and hand functions in stroke patients" has been started and find out the mCIMT is more effective than Mirror Therapy (MT) in different severity of stroke.

Rinskinijland et al. (2013) The therapy described in the mCIMT protocol is aimed at recovery in terms of neurological repair, by applying an impairment-focused intervention, while preventing the development of compensatory movement strategies. This approach is specified as the bottom up approach in the EXPLICIT-stroke mCIMT protocol, referring to the hierarchical levels of the International Classification of Functioning, Disability and Health (ICF).[23]

Lepert J. Mitner et al. The foregoing evidence suggests that constraint induced therapy for chronic upper extremity paresis in adults after stroke would be associated with measurable neurophysiologic changes. Lepert J. Mitner et al were the first to demonstrate that CI therapy produces the large changes in brain organization and function, in laboratories he helped to set up changes that were correlative with the large changes in motor function that the therapy produced.[16]

Holloway M, (2003) et al. The functional changes in the brain that underlie the chronically maintained responses to training whether in healthy or in diseased adults, are referred to by the term neuroplasticity (or neural plasticity or brain plasticity). It has generally been assumed that such changes involve physiological or microscopic structural alteration of neurons or neuronal circuits such as efficiency of synaptic connections or the growth of new synapses, without gross structural changes. However it would be incorrect to assume that such structural changes do not occur on macroscopic scale.[17]

Limitations of present study are

- The number of mild disability post stroke cases was less.
- The therapy sessions taken by patients before involving in CIMT therapy and Mirror Therapy (MT) must be known.
- Less overall duration of study.
- Less sample size.
- Limited parameters were taken.
- No long term follow up was taken after 3 weeks.
- Measurements were taken manually which may produce human errors.

Future recommendations are

- Increase overall duration of study at least 1 year.
- Increase sample size at least 30 patients in each category (mild, moderate and severe disability post stroke)
- Increase number of parameters ,which can be : can add motor activity log or wolf motor scales and any functional scale for upper limb.
- Follow ups should be taken to assess long term effects.
- Measurements can also incorporate any automatic mechanical device if possible to avoid human errors.

Conclusion

This study concluded that Modified Constraint Induced Movement Therapy (mCIMT) is more effective than Mirror Therapy (MT) in upper extremity and hand functions in stroke patients.

In this study the patients from mild to moderate and moderate to severe post stroke disability mCIMT and Mirror Therapy (MT) both was improved better in stroke patients. But when we have compared than it showed Constraint Induced

Movement Therapy (mCIMT) is more effective than Mirror Therapy (MT) in upper extremity and hand functions in stroke patients. So hypothesis is accepted.

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