

An Effect of Modified Constraint Induced Movement Therapy Versus Bobath Therapy on Upper Extremity Motor Control and Performance in Subjects with Chronic Stroke

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Abstract: *Improving upper extremity function is often a core element of rehabilitation after stroke in order to maximize patient functional independence and reduce disability. The modified constraint induced movement therapy and Bobath therapy both are used to improve functions of paretic upper limb in subjects with chronic stroke. The study aims to compare the effectiveness of modified constraint induced movement therapy (mCIMT) with Bobath therapy in subjects with upper extremity dysfunction after stroke. Total 26 subjects with chronic stroke were randomly divided into two groups: 1 mCIMT (n=13) and 2 Bobath (n=13). Interventional protocol for 1 hour/day for 5 days/week for total 6 weeks duration for affected side upper extremity. In mCIMT group Unaffected upper extremity was restrained by hand glove for total 30% of waking hours/day for total 6 weeks duration. Both the group was received same conventional protocol for total 6-week duration. FMA-UE was used to assess upper extremity functions, WMFT was used to measure upper extremity motor performance and MAL-30 was used to assess upper extremity motor activity. The intra group comparison was done using Paired t-test which suggest highly significant improvements in both the groups. Results of independent t test suggest significant improvement in both the groups but more significant in group 1. The present study concludes that mCIMT and Bobath Therapy both are effective treatment strategies but mCIMT is more beneficial in improving upper extremity functions, motor control and performance in chronic stroke subjects.*

Keywords: Stroke Rehabilitation, Hemiplegia, Quality of Life, Activities of Daily Living

1. Introduction

Stroke is one of the leading causes of morbidity and mortality worldwide.^[1] In 2016, the Global Burden of Disease project estimated the number of stroke cases in India to be 1,175,778.^[2] Female have higher incidence of stroke than male according to World Stroke Organization (WSO).^[3] Age at onset of most patients with stroke worldwide is older than 65 years.^[4] The average age is 45 - 64 years.^[5] According to the world health organization stroke was defined as: A clinical syndrome characterized by rapidly developing signs of focal (or global) disturbance of cerebral functions, with symptoms lasting ≥ 24 hours or leading to death with no apparent causes other than vascular origin.^[6]

The original Constraint Induced Movement Therapy (CIMT) involves the restraint of the individual's unaffected upper extremity with the use of a safety mitt. The mitt is left on for 90% of waking hours of the day, over a 2-week intervention period in conjunction with 6 hours in a day, 5 days of the week of task-specific training.^[7] An increased amount of practice task and longer restraint time may be dangerous for patients during the treatment period. In addition, patients may have difficulty with full compliance for this prolonged practice session; thus, the clinical feasibility of CIMT has been questioned.^[8] Page and colleagues designed a modified CIMT (mCIMT) that shortens both the intensive training session of the paretic upper extremity (30 minutes/day –

2 hours /day) and the restraint time of the nonparetic upper extremity (<6 hours/day).^{[9][10]}

Bobath concept/approach was published by Bertha and Karl Bobath in 1990.^[11] Bobath explained movement dysfunction in hemiplegia from a neurophysiological perspective stating that the patient must be active while the therapist assists the patient to move using key points of control and reflex inhibiting patterns.^[11] Bobath therapy involves facilitation and encourages natural movements of the limb. mCIMT that involves restraining unaffected hand during treatment and Bobath which doesn't involve restraining unaffected hand are found to be effective individually

Upper limb impairments post stroke varies from patient to patient and it affects the ADLs also. These both therapy works on the different domain of the ICF, mCIMT works at functioning and participation level and it is task specific whereas Bobath works on the impairment level. CIMT has been proven by previous studies^{[12][13]} but it involves longer duration of restraining the unaffected arm which sometimes difficult to implement, as patient sometimes grow tired of wearing Mitt.^[14] which compromise adherence to the protocol. Bobath is a traditional approach which also improves upper limb function.^{[15][16]}

For rehabilitation purpose the evidence is needed to find the better treatment approach and till date very few

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studies are there which compares CIMT and Bobath but no study has been there which compares mCIMT and Bobath, thus the aim of the study is to compare the effectiveness of modified constraint induced movement therapy (mCIMT) with Bobath therapy in subjects with upper extremity dysfunction after stroke.

2. Materials and Methodology

Institutional ethical approval was taken from the Institutional Ethical Committee of Apollo Institute of Physiotherapy. prior permission from the administrator of rehabilitation centers was taken. After self-introduction, explanation of the study procedure and written informed consent was obtained from all the subjects. Total 26

(1) Group -1 (mCIMT):

Table 1: mCIMT Protocol

No.	Exercise	Repetition And Sets
1	Repetitive task specific training of various ADLs	20 RM x 3 sets ^[18]
2	Skilled task training	20 RM x 3 sets ^[19]

RM= Repetition Maximum, ADLs = Activities of Daily Livings

Total 13 subjects were taken to mCIMT group. All the exercises were given to the subjects along with shaping techniques that were focused on improving movements involving the maximum deficit for 1 hour/day for 5 days/week for total 6 weeks duration for affected side upper extremity. The difficulty of the tasks was continuously increased in small steps and proper verbal reinforcement was given for the slightest improvement in performance time or quality of movement.

Unaffected upper extremity was restrained by mitt/sling/hand glove for total 30% of waking hours/day (min 5 hours/day, 5 days/week for total 6 weeks duration.^[20]

Exercise protocol at clinic

- Putting pegs in a pegboard and taking them out.
- Practice writing with pen/pencil.
- Turning pages in a book
- Pinch clothespins
- String beads
- Put together puzzles
- Pick up small objects like buttons, coins, stones etc., and put them into a box
- Pick up empty glass and then put them back down
- Folding towel/napkin
- Roll a pencil between the thumb and fingers
- Place your hand on the table and try to lift each finger one at a time off the table
- Ball squeezing

subjects with confirm diagnosis of stroke, age between 45 to 70 years, both male and female, who willing to participate in the study, post stroke duration > 6 months, Brunnstorm stage ≥ 2 .^[17] and who is able to follow commands were include into the study. Subjects with severe cognitive impairments (mini cog < 4), severe visual problems, glenohumeral subluxation of shoulder joint were excluded. pre-intervention data was taken using Fugl-Meyer Assessment for Upper Extremity Scale, wolf motor function test and motor activity log-30 on first day of the study. After that subjects were divided into two groups: group 1 (mCIMT) (n=13) and group 2 (Bobath therapy) (n=13) using Convenient Sampling Method. post intervention data was taken after 6 weeks.

Exercise protocol at home

Home activities like:

- Reaching for and grasping a cup.
- Proper use of eating utensil (spoon, fork).
- Using a hair brush or combs
- Tying shoe lace.
- Buttoning a shirt.
- Open and closes drawer.
- Brushing teeth.
- Opening and closing door with the use of a key.
- Flipping cards.
- Grasping and releasing a can.

In giving mCIMT in home setup while doing home activities with restraint over unaffected upper limb. There should be a care giver to monitor the subject when he/she was doing activities at home. specific exceptions from this rule were listed, such as sleeping, use of water, and any activity where having the unaffected arm restrained might affect safety. The patients kept a diary in which they recorded all the activities that were performed with the affected arm either with the mitt/hand glove in place or removed.

(2) Group 2 (Bobath therapy)

Total 13 subjects were taken Bobath therapy for 1 hour/day for 5 days/week for total 6 weeks duration for affected side upper extremity.

Table 2: Bobath therapy protocol

No.	Exercise	Repetition And Sets
1	Upper extremity weight bearing exercise Weight bearing over affected side: sitting in a couch with the elbow extended, wrist extended and hand placed several inches away from hip	Hold 15-30 second, 2-4 repetitions.
2	Auto inhibition techniques Sitting - keeping affected hand flat on the table, the position of the hand on the table is marked with chalk and allowing to do activities in unaffected hand like writing, painting etc.,	20 RM x 3 sets ^[21]
3	Bimanual techniques of various task Sitting with both hands clasped together placed on a table, pushing a ball or some other object. Reach out activities with both the hand clasped together in high sitting/standing position Picking up objects with sound hand and transferring to the affected side (Various sized and shaped objects)	20 RM x 3 sets ^[20]
4	Facilitation techniques. Facilitation of slow controlled movements- When attempting with any task patient is encouraged to do slowly) (as quick movements increase the flexor synergy in hand). movement facilitation of scapular protraction, shoulder flexion, elbow extension, wrist extension, and finger extension and opposition.	20 RM x 3 sets ^[20]

RM =Repetition Maximum

Motor progression of individual participants monitored throughout the intervention sessions. If the participants could move independently, the therapist withdrew some assistance to encourage their autonomous abilities to control movement. If the participants were tired or experiencing muscle stiffness during the session, resting and repetition of the muscle tone preparation was allowed before returning to the practice. All the exercises will be do along with normalization of tone.

Both the group will receive same conventional protocol including Stretching exercise, Range of motion exercise, Strengthening exercise, Mat exercise and Gait training for 40-45 min/day, 5 days/week for 6-week durations.

Statistical Analysis

Data was analysed using statistical software SPSS version 26 and Microsoft excel 2021.The data was screened for normal distribution using Shapiro-wilk test according to that the data was normally distributed. Parametric test was applied to see the effect of modified constraint induced movement therapy and Bobath therapy on upper extremity motor control and performance in subjects with chronic stroke. For within group analysis Paired t-test was used to see the effect of modified constraint induced

movement therapy and Bobath therapy on upper extremity motor control and performance in subjects with chronic stroke. For between group analysis independent t-test was used to compare the effect of modified constraint induced movement therapy and Bobath therapy on upper extremity motor control and performance in subjects with chronic stroke. Statistical significance level was kept at 5%.

3. Result

The present study was conducted to see the effect of modified constraint induced movement therapy versus Bobath therapy on upper extremity motor control and upper limb performance in subjects with chronic stroke. Total 26 subjects were included in this study. Each group consists of 13 subjects. Here, table no.3 shows demographic details and characteristics data of all subjects. Table no.4 shoes the distribution of subjects according to their Brunnstorm stage. Table no.5,6 and 7 shows within group analysis of both the group using FMA-UE, WMFT and MAL-30 scales. Table no.8,9 and 10 shows between group analysis of both the group using FMA-UE, WMFT and MAL-30 scale.

Table 3: Basic demographic details and characteristics data (N=26)

Descriptive Details		Group 1	Group 2	Total
AGE (YEARS) (MEAN±SD)		58.07±9.42	56.62±8.72	57.31±8.87
ONSET OF STROKE (MONTHS) (MEAN±SD)		22.54±16.83	53.69±47.13	28.12±35.13
GENDER	MALE (N (%))	6(46.15%)	3(23.07%)	9(34.61%)
	FEMALE (N (%))	6(46.15%)	10(76.92%)	17(65.38%)
TYPE OF STROKE	HEMORRHAGIC (N (%))	3(23.07%)	3(23.07%)	6(23.07%)
	ICHEMIC (N (%))	10(76.92%)	10(76.92%)	10(76.92%)
DOMINANT HAND	RIGHT (N (%))	13(100%)	12(92.30%)	25(96.15%)
	LEFT (N (%))	0(0%)	1(7.69%)	1(3.84%)
AFFECTED HAND	RIGHT (N (%))	9(69.23%)	7(53.84%)	16(61.53%)
	LEFT (N (%))	4(15.38%)	6(46.15%)	10(38.46%)

SD - standard deviation

Table 4: Distribution of subjects according to their brunnstorm stage in both group

Brunnstrom Stage	Group 1	Group 2
≤ 2	0	0
3	5	2
4	2	4
5	5	6
6	1	1

Within Group Analysis

Table 5: Within group analysis in FMA-UE scale of both groups

Group	PRE-INTERVENTION (Mean±SD)	POST INTERVENTION (Mean±SD)	't' VALUE	'p' VALUE
Group-1	36.3846±14.78	56.7692±8.96	-8.238	0.000*
Group-2	33.46±9.41	44.69±11.75	-6.858	0.000*

P = level of significance, t = paired t test, SD = standard deviation, FMA-UE=Fugl-Meyer Assessment for Upper Extremity Scale

*Significant at <0.05,

Table 6: Within group analysis in WMFT of both groups

Group	PRE-INTERVENTION (Mean±SD)	POST INTERVENTION (Mean±SD)	't' VALUE	'p' VALUE
Group-1	34.6154±18.25	58.3846±15.31	-10.738	0.000*
Group-2	22.92±8.27	36.92±10.75	-10.062	0.000*

P = level of significance, t = paired t test, SD = standard deviation, WMFT = Wolf Motor Function Test

*Significant at <0.05,

Table 7: Within group analysis in mal-30 of both groups

Group	PRE-INTERVENTION (Mean±SD)	POST INTERVENTION (Mean±SD)	't' VALUE	'p' VALUE
Group-1	92.6154±51.15	140.4231±59.27	-5.755	0.000*
Group-2	56.23±29.75	70.69±37.56	-4.369	0.001*

P = level of significance, t = paired t test, SD = standard deviation, MAL-30 =Motor Activity Log - 30

*Significant at <0.05,

Between Group Analysis

Table 8: Mean difference in FMA-UE in both groups

Group	MEAN DIFFERENCE		't' VALUE	'p' VALUE
	MEAN	SD		
Group-1	20.38	8.921	3.085	0.005*
Group-2	11.23	5.904		

P = level of significance, t = paired t test, SD = standard deviation, FMA-UE=Fugl-Meyer Assessment for Upper Extremity Scale

*Significant at <0.05,

Table 9: Mean difference in WMFT in both groups

Group	MEAN DIFFERENCE		't' VALUE	'p' VALUE
	MEAN	SD		
Group-1	23.77	7.981	3.737	0.001*
Group-2	14.00	5.017		

P = level of significance, t = paired t test, SD = standard deviation, WMFT = Wolf Motor Function Test

*Significant at <0.05,

Table 10: Mean Difference in MAL-30 In Both Groups

Group	MEAN DIFFERENCE		't' VALUE	'p' VALUE
	MEAN	SD		
Group-1	47.808	29.9496	4.014	0.001*
Group-2	14.000	5.0166		

P = level of significance, t = paired t test, SD = standard deviation, MAL-30 =Motor Activity Log - 30

*Significant at <0.05

4. Discussion

In this study, to promote clinical compliance, modified version of CIMT was employed in which the duration of restraint was combined total of 5hours/day and intermission was freely allowed on request. Present study shows improvement in mCIMT group post intervention. It can be achieved by following mechanism: overcoming learned non-use and use dependent neural spasticity.^[22] mCIMT allowed practice of the more affected arm and hand which improves motor learning skills and training with functional changes. This finding is also consisted with a study done by Levine P.et al.(2004).^[9] In this present study all the subjects show improvement in hand function which can be explained by Motor control and motor learning theories. Motor control improves when there is an active participation of patients which is important in activation and facilitation of motor neurons. Repeated movements using movement facilitation enhanced sensory stimulation to the sensorimotor cortex through the stimulation of exteroceptors and proprioceptors.^[23] These sensory inputs are then enhanced the activation of motor cortex as well as motor pathway, resulting in better control of movement.^[24] Both mCIMT and Bobath improves the upper limb function in all the outcomes measures but in present study when it is compared between groups, the group who received mCIMT proved to be more effective and it can be explained by more actual functional movements which patients are using in ADLs were given to be practiced. Thus, it was more of a task specific approach which acts at the 'participation' level of International Classification of functioning (ICF). The results are consisted with a study done by Kumar S.S et al. (2021) ^[17]in which they have given the CIMT to one group and compared it with the Bobath group. The result of the present study agreed with the result of a systematic review done by Maria J. diaz-arribas et al. ((2018) ^[16], they conclude that The Bobath concept is not superior to other approaches for regaining mobility, motor control of the lower limb and gait, balance and activities of daily living of patients after stroke. There is moderate evidence regarding the superior results of other approaches in terms of the motor control and dexterity of the upper limb.

5. Conclusion

Modified CIMT is a feasible alternative intervention for subjects with upper-extremity dysfunction after stroke. The current study revealed that when compared with Bobath, mCIMT could reduce the level of disability, improve the ability to use the paretic upper extremity, and increase the use of the paretic upper limb in activities of daily living. Improvements in ADL & hand functions are evident with both techniques by Statistical analysis and comparatively, mCIMT is found to be more Superior to Bobath. Hence it is concluded that mCIMT and Bobath both are effective treatment strategies but mCIMT is more beneficial in improving upper extremity functions, motor control and performance in chronic stroke subjects.

6. Limitations

Smaller sample size.
Lack of homogenous data.
Lack of follow up post intervention.
Home protocol was explained and followed by telephone but not supervised by therapist.

7. Future Recommendations

Another objective outcome can be examined
Larger sample can be taken with long term follow-up.
mCIMT can be given for other similar neurological conditions.

8. Clinical Implications

In this study, the frequency of the mCIMT and Bobath intervention program for improving upper limb motor function and upper limb performance was five times per week and continued for six weeks. The modified constraint induced movement therapy is one appropriate intervention for stroke individuals with moderate to severe level of deficits and provides task specific exercises for ADLs. In clinical practice, the modified constraint induced therapy is applicable in the conjunction with the other appropriate interventions in chronic stroke with moderate to severe level of deficits for better results. Hence it can be concluded that mCIMT can be incorporated to treat subjects with chronic stroke and bring early recovery of upper extremity motor functions to reduce their disablement and handicap in the society.

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