

ORIGINAL ARTICLE

Effect of Modified Constraint Induced Movement Therapy on Improving Hand Function of Stroke Patients

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ABSTRACT

Objective: The current study was aimed to assess the role of Modified constraint induced movement therapy (mCIMT) on hand function of hemiplegic patients.

Study Design: An experimental randomized control trial.

Place and Duration of Study: The study was conducted in Rural Health Care Hospital and Almeraj clinic, Nankana sahib from 1st may 2019 to 29th September 2019.

Material and Methods: Total 30 patients were recruited through non probability convenient sampling. Experimental group (15 subjects) received mCIMT and conventional therapy, while control group received only conventional treatment for 2 weeks. Fugl Meyer assessment scale and Motor assessment scale were used for assessment of treatment and control groups. Paired sample T-test was used for the comparison of before and after results of treatment and control groups. Mann-Whitney U test was used further to compare treatment and control groups independently.

Results: In upper arm function, the mean rank of control group and treatment groups were 9.37 and 21.63. The mean ranks of hand movements in control and treatment groups were 8.97 and 22.03 respectively. Advanced hand activities had mean rank of 10.07 and 20.93 in control and treatment groups respectively. Motor function had mean ranks of 9.07 and 21.93 in control and treatment groups respectively. Here the p value of Mann-Whitney U test is 0.00 which is less than 0.05, this shows that the test is highly significant.

Conclusion: It is concluded that modified constraint induced movement therapy has presented improved upper arm function, hand movements, advanced hand activities and motor function.

Key Words: *Fugl Meyer Assessment Scale, Hemiplegia, Modified Constraint Induced Movement Therapy.*

Introduction

Constraint means “to limit” induced means “leading to do something” thus constraint induced movement therapy means to restrict the one normal limb with a mitt or glove and use the other affected limb for activities. This technique is more beneficial in patients of cerebrovascular accident.¹

There are different methods used for CIMT and different treatment timings which affect the results of the study, which includes modified constraint induced movement therapy (mCIMT), massed practice and Forced Use. In all these methods, the unaffected extremity is limited with a mitt and the abnormal limb received below three hours of

treatment each day, below four hours per day for two weeks and no treatment to the abnormal extremity respectively. The affected limb performs tasks like lifting, throwing, holding objects, buttoning and catching. These approaches lead to improvements in motor activity and ADLs.^{2,3}

Modified constraint induced movement therapy (mCIMT) does not follow the same protocol as CIMT but has other sets of exercises after limiting the working hand with a splint and series of task oriented movements were performed with the weaker arm. It is not performed for 6 hours and patients don't need to wear splint for 90% of waking hours. Modified constraint induced movement therapy (mCIMT) considered to be best task specific approach for improving hand function, range of motion, quality of life, amount of improvement and advanced hand activities when measured with motor assessment scale, motor activity log and Fugl Meyer assessment scale as opposed to CIMT.⁴

Constraint induced movement therapy is based on two approaches: one is limiting the normal limb and

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second one is forceful practice of the abnormal extremity. This approach leads to permanent improved behavior of the abnormal extremity. This technique was developed after experimenting on monkeys, constraining the monkey's normal upper limb with the glove for days. Monkeys were able to use the affected limb for feeding and then they were able to achieve some of the functions with abnormal extremity. In the past, the affected limbs were not used and all the activities were performed by the healthy extremity which makes the affected limb even more prone to permanent disability.⁵ More than 24% of subjects having upper limb dysfunction, due to CVA, can get better by constraining the normal limb and utilizing the damaged extremity with different tasks. Modified constraint induced movement therapy has different results than constraint induced movement therapy that needs to be learned.⁶

Stroke is the major problem which causes functional disability in adults. Nine out of ten people described 75% permanent disability due to hemiplegia that leads to dependent living. Increasing number (300\130000) of stroke cases in Pakistan focused on great need of therapeutic rehabilitation of hemiplegic hands to improve their fine motor skills. Modified constraint induced movement therapy (mCIMT) is a newer therapy technique and has prospective of enhancement of function.⁷

The objective of this study was to assess the role of Modified constraint induced movement therapy (mCIMT) on hand function of hemiplegic patients.

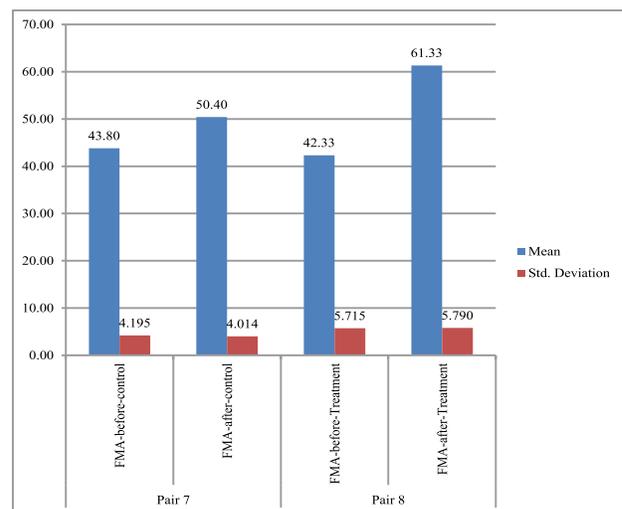
Material and Methods

This experimental randomized controlled study was conducted on hemiplegic patients (3 to 8 months) in Rural Health Care hospital and Almeraj clinic, Nankana sahib from may 2019 to September 2019. Total 30 patients recruited through non probability convenient sampling, aged between 40 to 60 years having minor spasticity of upper limb, able to extend wrist about 20 degree and interphalangeal joints about 10 degree were included for data collection. While those having pain (more than 4 on VAS), previous hand trauma and any psychological condition were excluded from the study. The subjects were enrolled after taking an informed consent for willingness to include in the study. 30 subjects (15 in each group) were divided in to two

groups by lottery method; experimental group was treated by modified constraint induced movement therapy (mCIMT) and by conventional therapy while control group was treated by only conventional therapy (Pnf techniques, grasp release and range of motion exercises) for 2 weeks. In the experimental group modified CIMT was done by limiting the normal hand with glove and series of functional tasks were performed with affected hand. Non parametric Data was collected by using Motor Assessment Scale (upper arm function, hand movements and advanced hand activities) and Fugl Meyer assessment scale (motor function) before and after the treatment, paired sample T-test was used to check pre and post effects in control and treatment groups and Mann-Whitney U test was used to measure the difference between treatment and control groups. The results were then evaluated by SPSS (v. 20).

Results

Thirty subjects were treated through Modified CIMT (treatment group) and conventional therapy (control group) after division into two groups. The mean and standard deviation values of pre control group are 43.80± 4.195, while 50.40± 4.014 is the mean and S D of post control group treated by only conventional therapy. 42.33± 5.715 is the mean and standard deviations of pretreatment group while 61.33± 5.790 is the mean and standard deviations of post treatment group which is highest mean and standard deviations than all the other values. This depicts that



*Frequency distribution of Fugl Meyer assessment scale.
Fig 1: Frequency Distribution of Motor Function in Control and Treatment Group (N= 30)

mCIMT (treatment) group showed better results as the mean and standard deviation of mCIMT group after application of therapy is 61.33 ± 5.790 which is higher than conventional group (50.40 ± 4.014).

Table I: Frequency Distribution Between Control (Pre and Post) and Treatment Group (Pre and Post) (N= 30)

Motor Assessment Scale	Control Group(Conventional Therapy)			Treatment Group(Mcimt)		
	Pre Mean \pm S.D	Post Mean \pm S.D	P value	Pre Mean \pm S.D	Post Mean \pm S.D	P value
Upper arm function	2.47 \pm 1.187	4.20 \pm 1.146	0.000	3.20 \pm 1.082	5.80 \pm 0.561	0.000
Hand movements	1.40 \pm 0.737	2.87 \pm 0.834	0.000	1.93 \pm 0.799	4.80 \pm 0.862	0.000
Advanced hand activities	1.00 \pm 0.000	1.93 \pm 0.961	0.002	1.00 \pm 0.000	3.47 \pm 0.990	0.000

*Paired sample T-test comparing pre and post values of treatment and control groups.

*S D = standard deviation.

Paired sample T-test collectively shows the level of improvements in the results of patients who were treated with modified CIMT in treatment group. Firstly Upper arm function in post conventional group showed mean and standard deviation of 4.20 ± 1.146 which is less than post treatment group (5.80 ± 0.561). Secondly hand movements improved with mean of 2.87 and standard deviation 0.834 in post control group which is less than the mean and standard deviation of post mCIMT group (4.80 ± 0.862), Thirdly advanced hand activities are more advanced form of activities in motor assessment scale and its values are higher in post treatment group which is 3.47 ± 0.990 and post conventional group have values of 1.93 ± 0.961 , which is less than post treatment values.

Here the p value for both groups is 0.000, which is less than 0.05. There is statistically significant difference exist between motor assessments scales of post control and post treatment groups.

After comparing pre and post treatment and pre and post control groups. Now compare the difference between treatment and control groups. In Upper arm function the mean rank of control group is 9.37, while in treatment group it is 21.63 which is higher than control group. The mean ranks of Hand movements; in control and treatment group are 8.97 and 22.03 respectively. Advanced hand activities have mean rank of 10.07 and 20.93 in control and treatment group respectively. In the control and treatment group motor function have values of 9.07

Table II: Comparison between Treatment and Control Groups (N= 30)

	Group 1	N	Mean Rank	Sum of Ranks
UAF Control and Treatment	Control	15	9.37	140.50
	Treatment	15	21.63	324.50
	Total	30		
HM Control and Treatment	Control	15	8.97	134.50
	Treatment	15	22.03	330.50
	Total	30		
AHA Control and Treatment	Control	15	10.07	151.00
	Treatment	15	20.93	314.00
	Total	30		
MF Control and Treatment	Control	15	9.07	136.00
	Treatment	15	21.93	329.00
	Total	30		

UAF = Upper arm function

HM = Hand movements

AHA = Advanced hand activities

Table III: Mann-Whitney U Test Comparing Treatment and Control Groups (N= 30)

	UAF control and treatment	HM control and treatment	AHA control and treatment	MF control and treatment
Mann-Whitney U	20.500	14.500	31.000	16.000
Wilcoxon W	140.500	134.500	151.000	136.000
Z	-4.069	-4.165	-3.486	-4.066
Asymp. Sig. (2-tailed)	.000	.000	.000	.000

*Mann-Whitney U test used for comparison between independent groups.

*p < 0.05 was taken as level of significance.

UAF = Upper arm function

HM = Hand movements

AHA = Advanced hand activities

and 21.93 respectively. Control group showed less values of mean ranks than treatment group, which shows that there is increase in upper arm function, hand movements, advanced hand activities and motor function in treatment group. Here the p value of Mann-Whitney U test is 0.00 which is less than 0.05, this shows that the test is highly significant.

Discussion

Modified constraint induced movement therapy when used with conventional therapy shows better results in performing complex hand movements and functional tasks than other treatment options like pnf techniques, grasp release exercises combined with range of motion. There were improvements in upper arm function, hand movements, advanced hand activities and motor function in the affected

hand and fewer improvements in control group. In Upper arm function the mean rank of control group and treatment groups were 9.37 and 21.63, which was higher than control group. In the same manner, the mean rank of Hand movements; in control and treatment group were 8.97 and 22.03 respectively. Advanced hand activities have mean rank of 10.07 and 20.93 in control and treatment group respectively. Motor function had values of 9.07 and 21.93 in control and treatment groups respectively. Control group showed less value of mean ranks than treatment group. Here the p value of Mann-Whitney U test is 0.00 which is less than 0.05, this shows that the test is highly significant. The results of the study are same as suggested by Taub, et al.⁸ that upper arm function, hand movements and advanced activities are improved; when normal hand is immobilized with a mitt and series of tasks are being performed by affected hand with conventional therapy. Collecting the beans, holding objects and placing them to the desired point have been made easy by 2 weeks exercise session and following follow up. Our results are also supported by Priyanka and Bijayeta.⁹ they conducted a randomized controlled trial on hemiplegic patients of sub-acute stage. 20 subjects have been treated by modified constraint induced movement therapy mCIMT (normal hand was covered by a glove) for 2 hours and control group has been treated by conventional therapy for 2 hours. Motor function and daily functional activities got better in affected hand through mCIMT. Fugl-Meyer assessment (FMA) explained the mean and standard deviation increased in treatment group (77.11 ± 2.22) than control group. While on the contrary, Hartman, et al.¹⁰ compared the effects of constraint induced movement therapy with mirror therapy on upper extremity dysfunction due to cerebrovascular accident in sub-acute and chronic stage. Visual feedback has been given through mirror therapy and leads to illusion of both arms function normally. While there has been fewer improvements in other group treated by CIMT and conventional treatment as there is no visual feedback and upper limb remained in previous state of immobility with minor changes. The patients who received CIMT with mirror therapy have been improved (P value 0.0001) while others showed minor improvements in stroke patients.

Similar results were reported by other researcher that CIMT alone showed better results when compared with conventional therapy for one month. It has better outcomes in improving daily task specific activities even in chronic stage of learned non-use of the immobile limb.¹¹ The same results have been explained by Sirtori, et al.¹² in a systemic review that when comparison occur among CIMT, modified constraint induced movement therapy, forced used phenomenon and conservative therapy or no treatment. There is improvement in those patients treated by modified constraint induced therapy as those patients were wearing mitt for not more than 2 hours and there was no specific two hour training which make them tired and stressed. There is significant increase in the mean and standard deviations (61.44 ± 2.33) of mCIMT group. In the same way, a meta-analysis has been conducted by Coleman, et al.¹³ the goal of the study is to find out the importance of modified constraint induced movement therapy (mCIMT) in ischemic stroke survivors when comparing with traditional therapy. Evaluation of data has been done by Fugl Meyer assessment scale, motor activity log, action research arm test and Wolf motor function test, to measure how well, how much quality of hand and wrist movement improved. The results of the study are supporting that mCIMT is much better technique with mean and standard deviation of 20.77 ± 1.00 which is higher than control group (18.99 ± 1.22). A randomized control trial was conducted on acute post CVA patients to check the effectiveness of constraint induced movement therapy. Fugl Meyer assessment scale was used before and after the treatment session on 30 patients for 2 weeks, which showed improved behavior of patients treated by CIMT as TMS showed parts of improvement in cerebral hemisphere.^{14,15} But a single blinded study was conducted by Dromerick, et al.¹⁶ on 40 stroke patients. They performed exercise sessions in hospital for 4 weeks and outcomes were different, which explained that the abnormal hand function improved in flexion but no increase in extension and functional activities improved in other group. Due to limited time duration, small sample size was selected to check the effects of modified constraint induced movement therapy (mCIMT) in stroke survivors. Further only single upper limb was

selected; there was no inclusion of quadriplegic patients. This study included only hemiplegic patients who had stroke in 3 to 8 months and age between 40 to 60 years, while stroke effects on younger population also who is below 35. Further there was no follow up assessments (feedback) were followed in this study which shows for how long improvements persists after quitting exercise. There were less coordinated movements present in hand due to stroke, which need more weight bearing and core stability exercises.

Recommendations

This study can help in further studies on mCIMT. Upcoming authors can also compare the effects of mCIMT with other exercise therapies to find out the best possible treatment for stroke. Further younger population can also affected by stroke which can be included in future studies. Only single upper limb was selected in hemiplegic patients, while studies can be performed on quadriplegic patients. We selected only small sample size of hemiplegic patients who had stroke in 3 to 8 months; studies can be performed on large sample size in acute or chronic stroke patients and other than stroke.

Conclusion

It is concluded that modified constraint induced movement therapy provides improved upper arm function, hand movements, advanced hand activities and motor function than conventional therapy for the patients with hemiplegic stroke.

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