Effectiveness Of Modified Constraint-Induced Movement Therapy Compared To Hand-Arm Bimanual Intensive Therapy On Quality Of Upper Extremity Function In Hemiplegic Cerebral Palsy Children - An Experimental Study

Dr. Trishala Jain*, Dr. Rahul Bisen, Dr. Parag Ranade*****

* MPT Final Year Student, ** Associate Professor, ***Professor & Head, Department Of Neuro Physiotherapy, Smt. Kashibai Navale College Of Physiotherapy, Pune 411041.

Abstract: Background: Hemiplegic Cerebral palsy (CP) impairs hand function leading to inability or difficulty to perform activities of daily living (ADLs). Beside traditional therapies several new techniques like mCIMT & HABIT are in practice which focuses on precise and appropriate targeted results. There is a need to include a treatment protocol which is effective, easy and can be done under parents' guidance in home setting. Purpose of this study was to find and compare the effect of mCIMT & HABIT on the quality of upper extremity function in children with hemiplegic cerebral palsy. Objectives: To study the effects of mCIMT, HABIT and conventional therapy on quality of upper extremity function in hemiplegic cerebral palsy children and to compare the effects of mCIMT, HABIT & conventional therapy on quality of upper extremity function in hemiplegic cerebral palsy children. Material & Methods: The study included 20 children who were diagnosed cases of hemiplegic CP. The experimental groups were given mCIMT and HABIT with conventional therapy and the control group received only conventional therapy. Quality of upper extremity skills test (QUEST) was used as an outcome measure. All groups were evaluated with the QUEST before and after 4 weeks of treatment. Results: The results showed statistical difference in the final QUEST scores(p=0.001) between all the groups as well as difference in dissociated movement, grasp & weight bearing. There was however no difference in protective extension (p=0.704) domain. Also, there was statistically no significant improvement in weight bearing and protective extension within the group while dissociated movement, grasp and QUEST Score showed improvement. Conclusion: This study concluded that mCIMT is more effective than HABIT & CT alone in improving quality of upper extremity function in hemiplegic cerebral palsy children. [Jain T Natl J Integr Res Med, 2021; 12(2):45-50]

Key Words: Hemiplegic Cerebral Palsy, mCIMT, HABIT, QUEST.

Author for correspondence: Dr. Trishala Jain, MPT, Final Year Student, Department Of Neuro Physiotherapy, Smt. Kashibai Navale College Of Physiotherapy, Pune 411041E-Mail:jaintrishu12@gmail.com

Introduction: Cerebral palsy (CP) is a non-progressive disorder which occurs due to insult to the developing brain[1]. CP describes a group of permanent disorders of the development of movement and posture, causing activity limitation[2]. There may also be associated sensory and musculoskeletal problems[3]. In India, prevalence of CP is estimated at around 3 cases per 1000 live births[4].

The insult to the brain tissue may be pre-natal, natal or post-natal. Cerebral Palsy is classified based on broad terms such as topography, aetiology, neuroanatomic factors, etc. Spastic Hemiplegia is a type of Cerebral palsy in which one side of the body is affected. Usually, the upper limb is more affected than the lower limb. According to a study 30% of CP are hemiplegics with the population prevalence being 0.6/1000 live births. Children with hemiplegic CP show preference for using one hand, may keep hand coiled in a fist and close to the body. Hemiplegic children are not able to co-ordinate the activity between their head, arm and trunk thus leading to impairments in unimanual and bimanual tasks[5]. There is tendency to use wrist and elbow flexion, pronation of forearm and abnormal movements in the scapular and lateral trunk flexion to reach out and grasp[3].

Impaired voluntary movements are observed mostly affecting hand functions. Other functions affected are pincer grasp, supination of the forearm, and extension of the wrist. Impaired hand function is a major disability in hemiplegic children[6]. So, they learn to perform most tasks with their non-involved upper extremity (UE) due to failure of optimal use of the involved extremity. This leads to inability or difficulty to perform activities of daily living (ADLs), which is likely to reduce their independence and increase burden of care[7]. Since CP cannot be cured, management is focused on relieving symptoms and improving motor function.

According to the ICF model the manifestations of the impairments affects mainly structure, function and activity domains[8]. In treatment of CP, various approaches are based on different Theories of motor learning. E.g. NDT approach by Bobath, Therapeutic Hippotherapy, Sensory Integration, Therapeutic Hydrotherapy etc[9].

Several new techniques are in practice that focuses more on precision, appropriate targeted results and improved functional movement patterns such as modified constraint-induced movement therapy (mCIMT) and Hand-Arm Bimanual intensive training (HABIT).

CIMT is directed to treat by increasing the use of affected limb in functional activities called mass practice and constraining the less affected limb. This technique, developed by Edward Taub, applies constraint (like sling, mitt or glove) or restricts the sound limb in hemiplegic patients so that they are unable to use it. The patient is advised to use affected limb to its maximum, repeatedly and under supervision, hence increasing its capacity[8, 10, 11].

mCIMT is a less intense treatment that involves the same principles as CIMT (i.e. restraint of the less-affected upper extremity and practice of functional activities of the more-affected extremity), but with less intensity than traditional CIMT (i.e. less time).

Another protocol known as HABIT has been established. Its chief aim is to improve the use of both arms in daily function using the principles of motor learning, and neuroplasticity, to address these bimanual impairments.

This technique involves task performance using affected limb along with less affected limb in symmetrical or alternating movement pattern which simulates most of our daily activities. This approach gets the benefit of inter coupling of limbs and promote the activity in less affected limb through the sound limb[12].

Literature shows effectiveness of these strategies. However conflicting evidence is present on which one of these is more effective.

This research intends to add to the literature and contribute in reaching final conclusion about superiority of either intervention. This study aimed at determining the effectiveness of mCIMT as compared to HABIT on quality of upper extremity function.

Material and Methods: Permission was obtained from ethical committee of the institute. 24 children participated in the study. The parents were informed orally regarding the study as well as written consent was taken from them. The subjects were selected according to the inclusion and exclusion criteria and allocated as per convenience to Group A & Group B (experimental group) and Group C (control group). 1 dropped out from Group A & 2 from Group C due to personal reasons.

Inclusion Criteria: Children from both genders, 4-8 years of age with good cognition and level III and above on Manual Abilities Classification system (MACS), Ability to achieve minimum 10 degrees of active wrist extension, 10 degrees finger extension.

Exclusion Criteria: Children with severe spasticity i.e. grade 3&4, Children with upper extremity deformities, those who had Botox in last 6 months or operative interventions of upper limb were excluded.

Pre & Post treatment evaluation was done using QUEST of all the 3 groups. Interventions were given for 4 weeks.

GROUP A received mCIMT and Conventional Treatment (CT): Subjects unaffected extremity was restrained and then they were engaged in unimanual activities like board games, card games, puzzles, art & crafts etc. and conventional therapy for 2hrs per day along with rest periods. The training was carried out for 6 times a week for 4 weeks.

GROUP B received HABIT and conventional treatment: Bimanual activities that require use of both hands like clay activities, ball activities, cube activities, bottle & marble activities etc. and conventional therapy for 2hrs per day along with rest periods. The training was carried out for 6 times a week for 4 weeks.

GROUP C received conventional treatment: Stretching of affected UE, NDT, Weight bearing of affected UE, Manual dexterity exercises like grasp /release, Peg board activities.

Result: The study data was analysed statistically using the SPSS 17.0 software. All the statistical

tests were performed at the level of significance of 0.05 and confidence interval of 95%. Descriptive statistics were performed for all the baseline characteristics of the subjects. Paired t-test was used for within group comparison. One Way ANOVA (Analysis of Variance) Test was used for between group comparison. Total 24 subjects were included in study, in which 10 were females and 14 males i.e. 41.66% female and 58.33% male. Results showed that all the 3 groups produced a significant improvement in QUEST Score, DM, Grasp, WB when between group (intergroup) comparison was done. And Group A showed greater % effect.

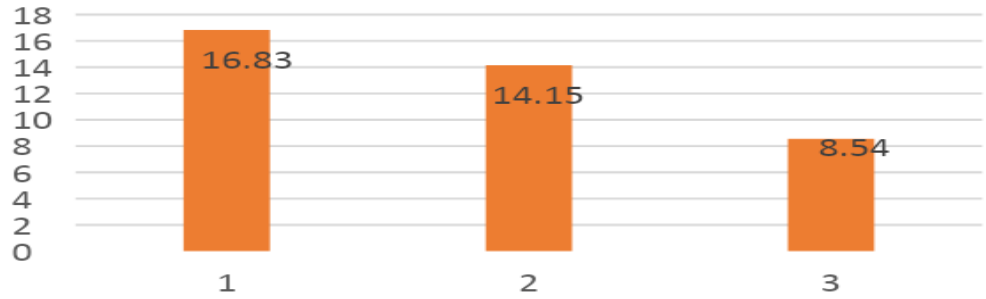
Table 1: Study Variables In Comparison Between Experimental And Control Groups

Variables		Mean	% Effect	SD	P-Value
Dissociated Movements	Group A	15.85	22.61	2.46	0.036
	Group B	13.09	18.56	3.00	
	Group C	11.20	15.81	3.48	
Grasp	Group A	16.93	35.56	2.91	0.001
	Group B	13.43	29.00	3.39	
	Group C	8.02	17.33	3.64	
Weight Bearing	Group A	6.86	9.92	1.57	0.000
	Group B	6.75	9.61	1.48	
	Group C	1.00	1.44	1.10	
Protective Extension	Group A	3.81	5.35	1.48	0.704
	Group B	3.45	4.78	3.68	
	Group C	1.85	2.59	6.94	
Quest Score	Group A	10.86	16.83	1.54	0.001
	Group B	8.05	14.15	1.95	
	Group C	5.52	8.54	2.89	

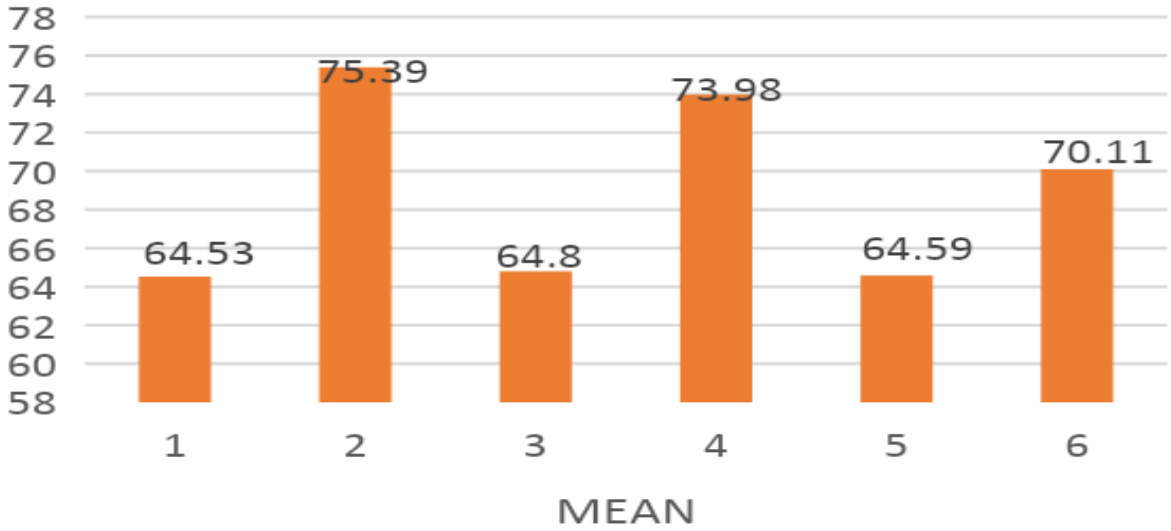
Table 2: Comparison Of Within Group Variables Of Study

Variables		Group A Mean ± SD	Group B Mean ± SD	Group C Mean ± SD
DM	Pre	70.09 ± 3.43	70.51 ± 3.17	70.83 ± 2.13
	Post	85.94 ± 2.71	83.59 ± 2.51	82.03 ± 1.64
	P value	0.000	0.000	0.001
Grasp	Pre	47.62 ± 4.98	46.30 ± 4.43	46.30 ± 2.03
	Post	64.55 ± 4.20	59.72 ± 4.17	54.32 ± 3.02
	P value	0.000	0.000	0.003
WB	Pre	69.14 ± 3.63	70.25 ± 3.77	69.67 ± 2.34
	Post	76.00 ± 3.46	77.00 ± 3.54	70.67 ± 2.42
	P value	0.000	0.000	0.076
PE	Pre	71.27 ± 4.31	72.15 ± 6.05	71.57 ± 6.61
	Post	75.08 ± 4.50	75.60 ± 6.89	73.43 ± 5.62
	P value	0.001	0.033	0.542
QUEST Score	Pre	64.53 ± 2.83	64.80 ± 2.80	64.59 ± 1.73
	Post	75.39 ± 1.90	73.98 ± 1.53	70.11 ± 1.43
	P value	0.000	0.000	0.005

Graph- 1: Between Group Comparison QUEST Score



Graph 2: Within Group Comparison QUEST Score



But there was no significant difference seen in PE as p value was greater than 0.05. And all the 3 groups produced a significant improvement in QUEST Score, DM, Grasp while WB & PE did not show significant improvement during within group analysis.

Discussion: This study suggested that the treatment using mCIMT is more effective than HABIT or CT alone on quality of upper extremity function in patients with hemiplegic CP. Results in this study showed that all the 3 groups produced a significant improvement in QUEST Score, DM, Grasp. While WB & PE did not show significant improvement when within group analysis was done. All 3 groups produced a significant improvement in QUEST Score, DM, Grasp, WB when between group comparison was done.

And Group A showed greater % effect. But there was no significant difference seen in PE as p value was greater than 0.05. The probable reason for greater improvement in overall QUEST Score in group A can be that as cerebral palsy is a non-progressive neurological condition resulting in motor impairments. Such impairments may result in activity limitation that require rehabilitation. During growth and development, children with hemiplegic cerebral palsy learn strategies and techniques to manage daily tasks with one hand.

Many cortical areas like primary motor cortex, dorsal premotor cortex and supplementary motor area shows increased electrical and metabolic neuronal activity during mCIMT. The results of our study are in accordance with the study done by Choudhary et al who evaluated

mCIMT efficacy on QUEST outcome tool. mCIMT improves dissociated movement because there exists specificity of training which provides better outcome on unilateral function. Grasp also improved in this group because the control on the distal parts is improved. Improvement in the weight bearing may be because of the combined improvement of dissociated movement and grasp in this group. Protective extension also improved but very less changes were seen.

mCIMT showed greater improvement as compared to conventional treatment. The reason is based on that mCIMT approach is based on an active rather than a passive view of motor learning; people learn by actively attempting to solve the problems inherent to a functional task, rather than repetitively practicing normal patterns of movement. It is becoming increasingly clear that the key to eliciting improvement in function is to provide sufficient practice.

However, rather than just focusing on repetition, the practice must be structured, based on how the central nervous system responds during learning; i.e. optimal responses with increasing movement complexity and provision of motivation and reward[13]. On the other hand, the used approach in conventional therapy focuses on decreasing of impairment and facilitation of normal movement pattern[14].

In accordance with Page et al[15] Myint et al.[16] found a more beneficial effect of modified constraint-induced movement therapy in such patients when compared to dose-matched standard rehabilitation, which included compensatory techniques and stretching[15,17].

HABIT group showed greater improvement as compared to conventional treatment. As HABITs intensity is far greater, providing sufficient opportunity for practice using principles of motor learning & rather than encouraging use of the involved hand in any manner, we specifically ask children to use it as a typically developing child uses their non-dominant hand. Grasp improved because treatment activities required use of both the hands. Specific activities were selected by considering the role of the involved limb in the activity (e.g. stabilizer, manipulator, active/ passive assist).

Weight bearing and protective extension also improved as both of the domains required bimanual coordination. And hence, bimanual activities helped to improve these domains. But protective extension improvement also requires proper functioning of sensory systems[18] along with the motor systems and thus, the improvements in protective extensions were not that significant. Thus, the findings of the present study and previous studies when compiled together prove that mCIMT was more effective in improving quality of upper extremity function when compared with habit and conventional therapy.

Conclusion: Current study, concluded that mCIMT is more effective than HABIT & CT alone in improving quality of upper extremity function in hemiplegic cerebral palsy children. More studies on the longer term follow up for carry over effect of the interventions must be undertaken.

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