THE EFFECTIVENESS OF MODIFIED CONSTRAINT INDUCED MOVEMENT THERAPY IN IMPROVING UPPER EXTREMITY FUNCTION IN CHILDREN WITH HEMIPLEGIC CEREBRAL PALSY

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Introduction

Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non progressive disturbances that occurred in the developing fetal or infant brain. Different therapies have evolved to treat this condition. One such new method of treatment is Constraint-induced movement therapy (CI or CIMT).

Constraint-induced movement therapy (CIMT) has emerged over the past decade as a promising intervention for reducing impairment and improving functional use of the affected upper limb in children with hemiplegia secondary to congenital brain injury (Charles & Gordon, 2005).

CI was developed by Dr. Eward Taub of the University of Alabama at Birmingham. Taub argues that, after a stroke, the patient stops using the affected limb because they are discouraged by the difficulty. As a result, a process that Taub calls "learned non-use" sets in, furthering the deterioration. It is this process that CI seeks to reverse.

These findings support the idea that cortical reorganization is possible in patients with neurological conditions and may explain the observed improvements in use of the affected upper limb.

Therefore, CIMT is also being used for treating children with hemiplegic cerebral palsy.

Tasks that are accomplished with the use of arms, hands and fingers, such as reaching, grasping and prehension are affected in children with cerebral palsy. Fine motor skills are also affected.

This study is attempted to find the effectiveness of CIMT on CP children, when given in modified way.

Aim: To determine the effectiveness of Modified Constraint Induced Movement Therapy in improving upper extremity function in children with hemiplegic Cerebral Palsy.

Methodology

Research Design: It's a Randomized Controlled study. Random assignment was employed in this design for assuring initial equivalence between different treatment groups.

Setting: The study was conducted in National Institute for Empowerment of Persons with Multiple Disabilities (NIEPMD), Govt. of India, and Chennai.

Sample Size: The sample size consists of 30 children with spastic hemiplegic Cerebral Palsy.

Participant: The 30 participants (age 3 to 5 years) who are diagnosed as having hemiplegic Cerebral Palsy were recruited for this study. Patients were assigned to one of the two groups.

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Table.1 Sample Characteristics of Participants

Sl No	Group	Total number	Age	Right hemi-plegic	Left hemi-plegic	M	F
1	Control	15	3-5	8	7	10	5
2	Experimental	15	3-5	9	6	8	7

Procedure
Thirty subjects were selected for the study. The selection of the subjects was done according to the inclusion exclusion criteria. Before selection informed consent was obtained from prospective participants and their parents.

After initial assessment on QUEST (Appendix IV), the control group received Conventional Occupational Therapy treatment. And Experimental group received mCIMT. Both control group and experimental group had therapy session for one hour per day, for three days a week and also they received home program for two hours up to **12 weeks,** control group received conventional occupational therapy, experimental group received modified CIMT. At the end of three months re- assessment was done. Data was statistically analyzed to determine the effectiveness of each therapy.

Intervention Protocols: Treatment sessions were one hour in duration. Children in the both groups were seen thrice a week for 12 weeks.

Intervention for Experimental Group: mCIMT
Restraint was given by Static Hand Splint.The modified constraint-induced movement therapy (mCIMT) protocol incorporated the two fundamental components of CIMT as described by Taub et al, the use of a restraint device (Static hand splint) and; the provision of massed practice to the affected upper limb (2 hours of home program). A static hand splint was worn on the hand of the non-affected upper limb to facilitate intensive practice of the affected upper limb. The static hand splint allowed the child to use the hand as an effective assist in bilateral activities, but did not allow active grasp of objects.

The intervention period was 12 weeks and involved wearing the splint 7 days per week. Children were expected to wear the splint for 3 hours per day, including therapy time and the home program, which could be split into different sessions of no less than 30 minutes duration. Families were expected to undertake an intensive home program of 2 hours per day. The intention of the home program was to facilitate an intensive period of practice with the affected limb and to educate, empower and include families and caregivers in the treatment process.

Families were provided with written and specific goals by the treating therapist after each session. These were based around development of specific hand skills such as grasp, hold, release, reach, in-hand manipulation. Families were discouraged from placing the splint on the child without supervision to avoid frustration.

Intervention for Control Group: Conventional Occupational Therapy
The conventional occupational therapy was underpinned by components of motor learning. This eclectic approach to treatment is commonly adopted by occupational therapists in the training of upper limb motor skills in children with cerebral palsy.

Motor Skill Acquisition, Motor Learning and Motor Control Theory
Practical application of a motor learning framework requires implementation of a motor-teaching model whereby the therapist acts as a teacher and the child, a learner. Factors required to facilitate a child's learning of motor skills include: giving attention to the context; motivation and prior knowledge; instructions; modeling; sequencing of tasks; mental and physical practice; repetition; facilitation-guidance; and feedback. Similar core components have been outlined for improving motor skills in children using a motor skills acquisition frame of reference. These frameworks, along with more recent advances in the knowledge of motor planning difficulties experienced by children with cerebral palsy, formed the core components of the conventional OT provided. Examples of the practical implementation of these principles included:
 (For Control group activities were given without constraint, For Experimental group activities were given by constraining the non affected hand with static hand splint).

Data Analysis and Results: 't' test was used for data analysis.

Comparison Between Pre And Post Test Means Scores Of Total QUEST SCORES In Control Group (CG).
Table and graph 1 showing the comparison between pre and post test means scores of total QUEST SCORES in control group (CG). The results shows that the intervention was statistically significant (p < .0001).

Table.1

S. No	Control group	N	Mean	SD	't' Value	'p' Value
1.	PRE	15	51.90	17.36	-7.94	< .0001
2.	POST	15	55.21	17.33		

Comparison Between Pre And Post Test Mean Scores of Total Quest Scores In Experimental Group (EG).
Table and graph 2 shows the comparison between pre and post scores of Experimental group. The results shows that the intervention was statistically significant (p< .0001).

Table .2

S. No	Experimental Group	N	Mean	SD	't' Value	'p' Value
1.	PRE	15	58.10	18.17	-14.30	< .0001
2.	POST	15	70.12	16.86		

Comparison of QUEST Scores between Control Group (Conventional Occupational Therapy Intervention) and Experimental Group (Modified Constraint Induced Movement Therapy)
Table and graph 3 shows the "Average Score comparison" between control and experimental groups. This result also showed high significance (p< .0001).

Table .3

S.No.	Group	N	Mean	SD	"t" Value	"p" Value
1	Control	15	7.02%	.0395	7.15	**<.0001**
2	Experimental	15	23.51%	.1093		

Discussion
Summary of Findings
The study's hypothesis was that there would be a statistically significant improvement in the upper extremity function in children with hemiplegic Cerebral Palsy who receive mCIMT compared to the children who receive Conventional Occupational Therapy intervention.

Tables and graphs 1 & 2 show the Comparison between pre and post test mean scores of each intervention group. The findings suggest that there was statistically significant difference (p< .0001), i.e. Improvement of upper extremity function was found in both the Control group (Conventional O.T) and the Experimental group (mCIMT).

Also Table and graph 3, shows the Average Score comparison of QUEST scores between the control and experimental groups. This result also showed high significance (p< .0001).The improvement of the Upper Extremity function was three fold more in the Experimental group (mCIMT) than the Control group (Conventional O.T).

That is, the **Control group (Conventional O.T.)** showed an average of **7.02%** improvement, whereas the **Experimental group (mCIMT)** showed **23.51%** of improvement in upper extremity functions of children with hemiplegic Cerebral Palsy.

Therefore this study results reveal that Modified Constraint Induced Movement Therapy is more effective than Conventional Occupational Therapy intervention in children with hemiplegic Cerebral Palsy.

Other Findings
Grasp Component- In the control group, out of fifteen, 4 children progressed from never having grasped an object to a primitive grasp for the first time, whereas others refined their grasp. In experimental group 5 children progressed from never having grasped an object to a primitive grasp for the first time, whereas others refined their grasp. All children in both groups showed improvements in weight bearing and protective extension.

Hand Function Rating- The rating ranging from 0 to 10, zero meaning poor and 10 meaning good. Control group children had an average improvement of 1 grade improvement. Whereas in the experimental group an average improvement of 2 grades progression was noted.

Spasticity- this is rated as none, mild, moderate or severe. Most of the children in both groups improved from severe to moderate or moderate to mild.

Co-operation- Level of co-operation was differed between clients of both the groups from somewhat cooperative to very cooperative.

Explanation of Findings
Are There Other Studies Which Support The Favorable Results For First Hypothesis?
Results from this study are consistent with other studies in showing a significant improvement in upper limb function after modified Constraint Induced Movement therapy in children with CP (Willis et al. 2002, Taub et al. 2004).[43] A key difference of this study and the new finding is that the improvements in upper limb function were three fold more than Conventional Occupational Therapy intervention.

Smania N, Aglioti SM, Cosentino A, (2009) in a study used Modified constraint Induced Movement therapy to improve paretic arm function in children with Cerebral Palsy. This study result supports the current study.

A feasibility study conducted by Wallen M, Ziviani J, Herbert R, Evans R, Novak I, concluded Modified constraint-induced therapy as implemented in this study was acceptable to participants. Over the intervention period, participants experienced improvements in the performance of important daily activities using upper extremity function as determined by the primary outcome measures.

Benefits of the Study
The method of restraint in this study was well tolerated, it was easy to administer and parents were happy to continue its use at home. The activities were appropriate and easily adapted to the children's abilities.

Conclusion
This study adds to the growing body of literature that indicates "Modified Constraint Induced Movement Therapy is an effective rehabilitative measure in improving the Upper Extremity Function of young Children with hemiplegic Cerebral Palsy than Conventional Occupational Therapy intervention".

Limitations and Recommendations
Limitations
1. The sample size was small. Further studies can be carried out on large samples.
2. A minimum age 3 years was selected for this study. To reduce the risk of neglect of the affected arm and to take advantage of plasticity within the brain, it could be argued that this method of intervention should be implemented much earlier.
3. The study did not include any other outcome measures for scoring except QUEST.
4. This study was a 12 weeks short term duration study. The long lasting effectiveness of the intervention protocols was not studied.
5. A further study would need to consider how to control and record home intervention accurately.

Recommendations
1. Sample size can be increased for conducting the therapy session.
2. Long term study can be conducted to find its effectiveness.
3. The study can be extended to other age groups.
4. Follow up studies can be extended.

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