

Modified Constraint Induced Movement Therapy (mCIMT) for Children with Hemiplegic Cerebral Palsy to Improve Upper Extremity Function: Pilot Study

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Abstract: *The purpose of this study was to identify effectiveness of modified Constraint Induced Movement Therapy (mCIMT) to improve upper extremity function in children with hemiplegic Cerebral Palsy. Ten children with hemiplegic cerebral palsy were included through convenience sampling procedure. The results found that there is statistically significant difference ($t = -4.68, p < 0.01$) between pre test & post test total score of QUEST scale. Further it found that there is statistically significant difference between pre test & post test scores of all QUEST components ($t = -3.07, p < 0.05$ for dissociate moment, $t = -2.93, p < 0.05$ for grasps; $t = -5.20, p < 0.01$ for weight bearing; $t = -22.90, p < 0.05$ for protective extension). Finally, this study concluded mCIMT for small children with hemiplegic cerebral palsy seems to be an important intervention method for improving upper extremity function.*

Keywords: hemiplegic cerebral palsy, Modified constraint induced movement therapy, upper extremity function, QUEST

1. Introduction

One hand functions well and other hand function has some degree of dysfunction for hemiplegic cerebral palsy (CP) children [1]. All forms of human activity like self-care, school or work and engagement in play or leisure activities are affected due to impairment of the upper limb [2]. Slow and weak, with uncoordinated movements, incomplete finger fractionation, spasticity and impaired tactile sensibility are common characteristics of the hemiplegic hand [3]. The cause of hemiplegic CP is heterogeneous: timing, location, and extent of the brain damage vary from one child to another [4]. The prognosis of the hemiplegic CP is depends upon different forms of lesion in the brain. The lesions are divided into three main groups based on literatures: (1). Cerebral malformation-a lesion of early fetal origin. (2). Periventricular lesions which occur in the most vulnerable part of the brain between 24th and 34th weeks of gestation; and (3). Cortical and subcortical lesions which occur in areas that are most vulnerable at term. Hand function was mildly affected in cerebral malformation compared to periventricular lesions and hand function was severely affected in cortical and subcortical lesions [5].

In occupational therapy, Neuro Developmental Therapy, Roods Approach, Biomechanical Approach and visuomotor priming [6] are used to train the upper extremity functions in Hemiplegic cerebral palsy. The effect of different types of hand function intervention program is uncertain due to lack of randomized controlled studies [7]. Researchers found that constraint induced movement therapy (CIMT) has been supported as an effective intervention program for adults who have had a stroke resulting in upper-limb-dysfunction [8]. The fundamentals of CIMT are: constraint of the unaffected hand to encourage the use of the affected hand; massed practice of the affected hand, and use of intensive techniques to train the affected hand [9]. Literature found that CIMT is effective method of treatment in hemiplegic cerebral palsy.

Risk factor using CIMT are: Some temporary loss of independence as the child will be using the affected arm to complete daily activities; There may be possible increase in frustration; Possible increase risk of injury to the involved arm and hand because the child is using the affected arm more but has decreased sensory awareness and motor control; In some children if a cast was used there have been reports of mild stiffness of the uninvolved hand upon cast removal [9]. In order to avoid risk factors in CIMT, current study modified the CIMT method and conducted pilot study to identify effectiveness of Modified Constraint Induced Movement Therapy (mCIMT).

1.1 Modified Constraint Induced Movement Therapy (mCIMT)

Constraint of the unaffected arm was achieved by gentle restraint, with an adult holding the child's unaffected hand during the activities. They were not restraint between activities but were allowed to have both hands free. Children were also encouraged verbally to use their other hand. A key difference of mCIMT is the improvements in upper limb function were achieved by using gentle restraint and verbal instruction.

Cortical reorganization after modified constraint induced movement therapy in pediatric hemiplegic cerebral palsy that underwent for 3 weeks clinical functional magnetic resonance imaging and magneto encephalopathy measurements were done at baseline after therapy and 6 months after therapy. mCIMT resulted in clinical improvement as measured by the pediatric motor activity log. Functional magnetic resonance imaging showed bilateral sensorimotor activation before and after therapy and a shift in the laterality index from ipsilateral to contralateral Hemiplegia after therapy. Magneto encephalography showed increased cortical activation in the ipsilateral motor field after therapy cortical reorganization was maintained at the 6 months follow up. This is the first

study to demonstrate cortical reorganization after any version of constraint induced movement therapy in a child with Hemiplegia. [10,11]

Operational definition of Modified CIMT

Gentle restraint of the unaffected arm and encouraged children verbally to use their affected hand for therapeutic activities, in between the therapeutic activity they were left free, bilateral work is advisable.

Operational definition of Hemiplegic Cerebral Palsy

Hemiplegic CP is defined as neurological disorder of movement and posture, associated with speech, hearing, vision and paralysis of one side of the body. Hands are more affected than legs.

2. Review of Literature

2.1 Literature related to modified Constraint Induced Movement Therapy (mCIMT)

Margaret Wallen, et al.,[12] conducted a study on “Effectiveness of modified constraint induced movement therapy for children with hemiplegic CP”. The purpose of the study is to determine the feasibility of family focused, modified constraint induced therapy with children with hemiplegic CP, to test study procedures in preparation for a randomized controlled trial. Ten children (median = age: 3 yrs 6 months) were assessed at baseline, at completion of intervention post baseline. Intervention consisted of a mitt worn on the unaffected hand for 2 hours per day for 8 weeks. Targeted adjunct therapy provided during the time the mitt was worn. Primary assessments include Canadian performance measure, Assisting hand assessment and the Melbourne assessment of unilateral upper limb function. Modified constraint induced therapy which targets participant - identified goals and which is family-focused warranted investigation utilizing randomized trial methodology.

Gordon A, et al.,[13] did a study on “effectiveness of modified constraint – induced movement therapy after childhood stroke”. The aim of this pilot study was to investigate feasibility, tolerability, and effect of modified constraint – induced movement therapy after (mCIMT) in children with hemiparesis after arterial ischaemic stroke (AIS). Eight participants initially recruited, six (one male, five females) completed mCIMT (median age = 12 years 3 months: range 6 years 10 months to 15 years). Children with chronic hemiparesis and impaired hand function after AIS had mCIMT for 2 hours a day, 5 days a week for 4 weeks. pre- and post- therapy assessments included indices of sensorimotor function, quality of upper limb movement, functional therapy goals, and child and parent interviews. Hemiparesis was predominantly spastic in three participants and dystonic in others all had severely impaired function. After mCIMT there were no significant improvements in sensorimotor function, or a quality of upper limb movement. All children improved in individual therapy goals related to functional performance. Children and parents were positive

about mCIMT is a promising intervention for children with chronic acquired hemiparesis. In this severely impaired group functional improvements were seen after their despite unchanged sensorimotor measures.

Naylore CE.,et al.,[14] conducted a pilot study to find out “effectiveness of modified constraint-induced movement therapy in young children with hemiplegic CP”. Nine children (six males, three females; median age 31 mo, age range 21 to 61 mo) presenting with congenital spastic hemiplegia (five right side, four left side) were involved in the study. It was a single-case experimental design using children as their own controls. Changes in hand function were evaluated with the Quality of Upper Extremity Skills Test. Improvement was seen throughout the study with statistical significance, using the Wilcoxon signed rank test, of 0.01 immediately after treatment. Assessment was at entry to the study and subsequently at 4-weekly intervals.

A 4-week baseline period with no hand treatment, controlling for maturation, was followed by a 4-week treatment period and a second 4-week period with no hand treatment to measure carry-over. Treatment consisted of twice-weekly 1-hour sessions of structured activities with a therapist and a home programme for non-treatment days. Only verbal instruction and gentle restraint of the unaffected arm were used to encourage use of the affected arm.

3. Methodology

3.1 Research Design

It is a quantitative research design analysis. A longitudinal study to compare the pretest and posttest scores of experimental group.

3.2 Participants

Ten children with hemiplegic cerebral palsy were recruited from special schools through convenience sampling procedure in Chennai. The inclusion criteria for the study were children with hemiplegic cerebral palsy and being aged between 36 months 60 months. Children with all degrees of impaired hand function were accepted for the study. Informed consent was obtained from all participating families and study was conducted after approval from the Ethical Research committee of the SRM college of Occupational Therapy, SRM University.

3.3 Instrument used in the study

QUEST scale (Quality of upper extremity skills test) was used to measure upper extremity function.

(i) Description

Carol Dematteo et al., [15] have developed the QUEST scale, the QUEST focus on upper extremity Quality of movement & planning intervention program. It is designed to be used with children who exhibit neuromotor dysfunction with spasticity and has been validated with children 17 months to 6 years The intention is to make the scale suitable even for subjects with mild to severe disabilities of cerebral

palsy children. QUEST was developed to specially to overcome the limitations of measures of hand function. It is a criterion – referenced test with good reliability and validity. It evaluates quality of upper extremity function.

(ii) Scoring procedure

The score must be entered in every scoring box even if the item is not tested (i.e., yes, no, not tested). Every effort should be made to complete the entire assessment. For any item for which the therapist is not sure of the child’s response or thinks the child is almost doing it, the score must be NO.

Score key:

✓ = Yes (Able to complete item according to specification).

X = No (cannot or will not complete item).

NT = Not tested (Not a able to administer item)

Yes = 2 points

No = 1 point

NT = 1 point

Each abnormal movement in posture section = -1 Point

(iii) Reliability

Inter rater reliability for QUEST total score was 0.96 (ICC). Inter- observer for 4 domains of QUEST (dissociate movement. grasps. Posture, protective extension, weight bearing) were 0.91, 0.91, 0.86, 0.61 (ICC) respectively. The test-retest reliability for QUEST total score was 0.75 to 0.95. Inter observer for 4 domains of QUEST (dissociate movement. grasps. Posture, protective extension, weight bearing) were 0.95, 0.95, 0.93, 0.79, 0.75, 0.85 respectively.

(iv) Validity

Construct validity was further investigated by correlating the QUEST with the therapist judgment of child’s level of hand function. The correlation between the QUEST total score and left and right hand functions ratings were 0.72 and 0.58 (p<0.001). The correlation between the chronological age and QUEST total score was 0.33 (p<0.01).

3.4 Data collection procedure

The purpose of the study was explained to the head of the institution. Ten subjects were included for this study from special schools in Chennai based on the screening criteria. Pre test was done by using QUEST scale. Modified Constraint Induced Movement Therapy (mCIMT) was given for the period of 20 sessions. Duration of the session was one hour per day for each child individually. Post test was done by using QUEST. Data was analyzed with SPSS, version 22.

4. Results

Table 4.1: Comparison of pre test & post test total score of QUEST

Test	M	SD	‘t’ value	LOS
Pre	122.89	28.97	-4.68	0.009
Post	160.40	23.29		

M-Mean; SD-Standard Deviation;

LOS-Level of Significance

Paired “t” test was used to find out effectiveness of mCIMT in hemiplegic CP. The results shows that there is statistically significant difference (t = -4.68, p < 0.01) between pre test & post test total score of QUEST scale.

Table 4.2: The Comparison of pre test & post test score of QUEST components

Components	Test	M	SD	‘t’ value	LOS
Dissociate movement	Pre	46.54	4.18	-3.07	0.037*
	Post	53.19	6.73		
Grasp	pre	22.73	13.74	-2.93	0.043*
	post	35.82	22.90		
Weight bearing	Pre	32.20	11.45	-5.20	0.006**
	Post	49.60	6.84		
Protective extension	Pre	27.52	12.20	-22.9	0.002**
	post	37.37	12.57		

M-Mean;SD-Standard Deviation;

LOS-Level of Significance

* P<0.05; ** P<0.01

Paired “t” test was used to compute the effectiveness of mCIMT in components of QUEST scale. The result shows that there is statistically significant difference between pre test & post test scores of all QUEST components (t=-3.07, p<0.05 for dissociate moment, t=-2.93; p<0.05 for grasps; t=-5.20, p<0.01 for weight bearing; t=-22.90, p<0.05 for protective extension).

5. Discussion

5.1 Effectiveness of mCIMT to improve upper extremity function in hemiplegic CP

The purpose of this study was to identify effectiveness of modified constraint induced movement therapy for children with hemiplegic cerebral palsy. Table 4.1 shows that there is statistically significant difference in upper extremity function between pre test and post test total score of QUEST (t= -4.680, P<0.01) in mCIMT group. The children were used playful activities with three trials that increase upper extremity function of affected arm. Each activity creates motivational interest to the children. Cortical activation in the ipsilateral motor field after mCIMT therapy is increased; cortical reorganization was maintained at the 6 months follow up [9].The results of this study is agrees with earlier studies. Stevan et al., [16] reported that the mCIMT showed greater improvement in motor changes than regular therapy. Researcher found [17] that after mCIMT completion, the patient exhibited substantial improvement in affected upper limb function. Literature [18,19] reported that patients receiving mCIMT produced more preplanned reaching movement than patients receiving traditional (TR) during the unilateral task. mCIMT produced a greater improvement in functional performance and motor control. Improvement of motor control after mCIMT was based on improved spatial and tallemportal efficiency, during bimanual rather than unilateral task performance. Hence the null hypothesis which states that there is no statistically significant difference between pre test and post test total score of QUEST scale in mCIMT group is rejected.

Table 4.2 shows that there is statistically significant difference in dissociate movement ($t = -3.075$, $p < 0.05$), grasps ($t = -2.930$, $p < 0.05$), Weight bearing ($t = -5.20$, $p < 0.01$) and protective extension ($t = -22.90$, $P < 0.01$) of QUEST components between pre test and post test score in mCIMT group. The children were practiced for playful activities with three trials with minimal restrained, children showed more interest towards each activity, motivational factors was increased by giving reinforcements that increases the upper extremity function. The results agrees with the earlier study of Naylor C.E, et al., [14] found that there was a statistically significant change in dissociate movement, grasp, weight bearing and protective extension components in mCIMT group.

6. Conclusion

The current study concluded that mCIMT for a small child with hemiplegic cerebral palsy seems to be an important intervention method for improving upper extremity function. Furthermore research is strongly recommended by using mCIT intervention for hemiplegic cerebral palsy children to conform the evidence.

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