

Constraint Induced Movement Therapy (CIMT) 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 Constraint Induced Movement Therapy (CIMT) 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 ($t=-5.53$, $p<0.05$) between pre test & post test total scores of QUEST scales. Further it found that there is statistically significant difference between pre test & post test scores in dissociate movement and grasps of QUEST components ($t=-3.80$, $p<0.05$; $t=-3.52$, $p<0.05$ respectively) and there is no statistically significant difference in weight bearing and protective extension of QUEST components ($t=-1.61$, $p>0.05$; $t=-1.93$, $p>0.05$ respectively). Finally, author concluded that CIMT are effective to improve upper extremity function in hemiplegic cerebral palsy.*

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

1. Introduction

The term cerebral palsy (CP) refers to a number of disorders of movement and posture due to a non-progressive abnormality of the immature brain [1]. It is a static motor impairment occurs during the pre natal, perinatal or post natal period with associated handicaps like vision & hearing defects, seizures, mental retardation, learning disabilities and feeding, speech and behavior problems. It occurs in about 1 of every 500 live births. Hemiplegic cerebral palsy in early childhood affects 1/1000 children.

Hemiplegic cerebral palsy usually results from occlusion of a cerebral artery during the perinatal period producing a stroke in the infants brain. Hemiplegic stroke occurs in utero or any time between birth and two years of age, it is considered hemiplegic cerebral palsy. These children are weak and spastic on one side of the body. Characteristically, the arm is more affected than the leg. The most common cause of hemiplegic cerebral palsy is cerebrovascular accident (CVA) commonly known as stroke. The acquired type of hemiplegic cerebral palsy can be the result of an accident or head trauma or birth complications [2].

1.1 Constraint Induced Movement Therapy (CIMT)

Constraint induced therapy originated from Taub's early work with monkeys. He studied monkeys where one of the forelimbs was surgically injured and the other forelimb was left intact. He observed that the monkeys would initially try to use the affected limb but were unsuccessful and restored to using the intact limb. Later the intact limb was restrained for 3 days and the monkeys used the affected limb. After he removed the restraint, he found that the monkeys continued to use affected limb. He hypothesized that disuse of the affected or involved limb is learned and with massed practice, the monkeys were able to use the affected limb again [3]. CIMT aims to improve the hand and arm use of children with hemiplegia. It involves physically constraint of

the uninjured arm to increase the use of more involved or affected arm. This type of therapy has been successful in children with hemiplegia. CIMT has been paired with intensive behavioral training or with less intensive practice involving traditional occupational services. CIMT has been developed as a result of neuroscientific research with monkeys. Researchers found that constraining with intact limb of monkey whose other limb has been deafferented. The monkey was able to learn to use the affected limb again. [4].

CIMT is multi faceted intervention that has several variations in its design ranging from method of restraints using a glove or mitt [5], Forearm splint [6], slings [7], short arm casts and long arm casts [8]. Limb is restrained varying from one hour per day [9] to 24 hours per day and for a period of 10 days [10] to months. Children with hemiplegic cerebral palsy have usually never used their affected upper limb normally. On the basis of Taub's early work with deafferented monkey, it has been suggested that plasticity of the brain could be a basis for rehabilitation with CIM therapy. Neuro imaging has shown a significantly increased cortical representation of the affected hand after CIM therapy [11].

In occupational therapy a various approaches are used to train the upper extremity functions in cerebral palsy hemiplegia based on motor relearning theory [12]. Constraint induced movement therapy is a traditional method used for the pediatric population. It has long been believed that brains of children are felt to have more capability than adults for cortical reorganization and it has been suggested that with asymmetric upper extremity motor control may also benefit from CIMT due to the massed repetitive practice for longer duration using restraint materials [13]. The current study was carried out to identify effectiveness of traditional method of constrained induced movement therapy (CIMT) to improve upper extremity function in children with hemiplegic cerebral palsy.

2. Review of literature

2.1. Constraint Induced Movement of Therapy (CIMT)

Pierce et al., [9] conducted a study on “effects of constraint - induced therapy (CIT) for a child with hemiplegic cerebral palsy (CP)”. A 12 year old boy with hemiplegic CP presented with decreased function in his left upper extremity, he was treated with a 3 week protocol of ‘CIT’ consisting of six 2 hours sessions of physical & occupational therapy and home practice. Improvements in upper extremity function were found in the mean and median time for completion of the wolf motor function test. The results suggest that CIT may be useful in treatment of upper –extremity dysfunction in hemiplegic CP.

Gordon AM, et al., [10] did a study to determine “methods of constraint - induced movement therapy for children with hemiplegic CP-development of a child-friendly intervention for improving upper extremity function”. The resulting intervention evolved from piloting and testing it with 38 children with hemiplegic CP who were between the ages of 4 and 14 years. Thirty-seven children successfully completed the treatment protocol. The intervention retains the 2 major elements of the adult CIMT (repetitive, practice, shaping) and was constructed to be as child-friendly as possible. It involves restraining the non involved extremity with a sling and having the child engage in unimanual activities with the involved extremity 6 hours a day for 10 days (60 hours). Specific activities are selected by considering joint movements with pronounced deficits and improvement of which interventionists believe have greatest potential. The activities are chosen to elicit repetitive practice and shaping. The intervention is conducted in groups of 2 to 3 children to provide social interaction, modeling, and encouragement. CIMT can be modified to be friendly while maintaining all practice elements of the adults CIMT.

Karman N, et al., [4] has conducted a study to find out “effectiveness of constraint induced movement therapy for hemiplegic children with acquired brain injuries (ABI)”. Seven consecutive rehabilitation admissions with hemiparesis were recruited without regard to injury etiology, age or cognitive capacities. The actual amount of use test (AAUT) was used to evaluate change in UE function. AAUT amount of use (AOU) and quality of movement (QOM) scales were obtained at baseline and followup. Results suggest that AOU and QOM item improvements were significant, as were changes in activities of daily living.

Glover, et al., [6] did a study on “the effectiveness of constraint induced movement therapy in two young children with hemiplegia”. Nineteen and thirty eight months old children were participated in this study, each of whom underwent trial of CIMT. It involves constraining use of the unaffected limb while providing intensive shaping and practice of movements in the hemiplegic limb. The technique had been shown to be highly effective in improving upper limb function in adults following stroke,

but there is only a limited literature on the use of this intervention in children.. Both children made significant gains in upper arm function that were reflected in a variety of domains, inducing aspects of every day functional limbs use. Gains persisted to variable degrees and some unexpected new gains were noted following cessation of CIMT.

Ann-Christen Eliasson et al., [5] has conducted a study on “effects of constraint induced movement therapy in young children with hemiplegic CP”-(age range 18 months to 4 years) and to make a comparison with conventional pediatric treatment. Twenty-one children (13 females, eight males) completed the CIMT programme and twenty children (12 males, eight females) served as a control group, children in the CIMT group were expected to wear a restraint glove for 2 hours each day over a period of 2 months. The training was based on principles of motor learning used in play and in motivational settings . To evaluate the effect of treatment, the Assisting Hand Assessment (AHA) was used. Assessment took place on three occasions: at onset, after 2 months and 6 months after the first assessment. A significant interaction was found between group and AHA measure.(ANOVA, $F(2,74) = 5.64, P = 0.005$). The children who received CIMT therapy improved their ability to use their hemiplegic hand significantly more than the children in the control group after 2 months. Effect size was high after treatment and remained medium at 6 months. As the treatment was tailored to each child’s capacity and interests, little frustration was experienced by the children.

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 children were selected from special schools through convenience sampling procedure in Chennai, India.

3.3. Screening Criteria:

(i) Inclusion criteria

- Diagnosis of congenital spastic Hemiplegic CP
- Age: 3-5 years.
- Right side hemiplegic cerebral palsy children
- Both genders.

(ii) Exclusion criteria

- Unilateral signs without diagnosis of Hemiplegia CP
- Bilateral sign
- Children with CP Hemiplegia along with severe mental retardation.

3.4 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., [14] 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 (can not 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, 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, protective extension, weight bearing) were 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 ($p < 0.01$).

3.5 Data collection procedure

The purpose of the study was explained to the head of the institution. Ten subject were selected from the two special school in Chennai based on the screening criteria. Consent form was obtained. Pre test was done by using QUEST scale. CIMT 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	106.54	30.12	-5.53	0.005
Post	137.55	34.50		

M-Mean;SD-Standard Deviation;

LOS-Level of Significance

Paired 't' test was used to find out effectiveness of CIMT in hemiplegic CP. The results shows that there is statistically significant difference ($t = -5.53$, $p < 0.005$) between pre test & post test total scores of QUEST scales..

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

Components	Test	M	SD	't' value	LOS
Dissociate movement	Pre	51.16	8.69	-3.80	0.019*
	Post	61.20	6.78		
Grasp	pre	21.52	11.62	-3.52	0.024*
	post	33.88	12.21		
Weight bearing	Pre	23.20	10.15	-1.61	0.181
	Post	26.80	7.82		
Protective extention	Pre	17.77	8.88	-1.93	0.193
	post	26.11	3.06		

M-Mean;SD-Standard Deviation;

LOS-Level of Significance; * $P < 0.05$.

Paired "t" test was used to compute the effectiveness of CIMT in components of QUEST scale. The results shows that there is statistically significant difference between pre test & post test scores in dissociate movement and grasps of QUEST components ($t = -3.80$, $p < 0.05$; $t = -3.52$, $p < 0.05$ respectively) and there is no statistically significant difference in weight bearing and protective extension of QUEST components ($t = -1.61$, $p > 0.05$; $t = -1.93$, $p > 0.05$ respectively).

5. Discussion

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

Table 4.1 shows that there is a statistically significant difference between pre test and post test total score of QUEST ($t = -5.53$, $P < 0.01$) in CIMT group. This is due to plasticity of the brain could be a basis for rehabilitation with CIM therapy [7] and cortical representation of the affected hand is increased after CIM therapy [15]. The earlier study done by Eliasson AC et al, (2005) reported that children received CIMT improved their ability to use their hemiplegic hand. Glover et al., [6] found that CIMT is highly effective in improving upper limb function. 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 CIMT group is rejected.

Table 4.2 shows that there is statistically significant difference in dissociate movement ($t = -3.80$, $P < .05$) and grasps ($t = -3.52$, $P < 0.05$) and there is no significant change in weight bearing and protective extension components in CIMT group. Charles et al., [7] reported that effectiveness of CIMT intervention is promising but may be dependent on the severity of the impairment. In current study, Two children was not eligible for test the protective extension components and one child scored same score in pre test & post test in weight bearing component due to the moderate to severe spasticity abnormality. This impact caused no significant change in weight bearing and protective extension components. The following limitations were noticed in this study: Sample was not matched by age gender and severity of impairment; small sample size and convenience sampling procedure.

6. Conclusion

CIMT involves restraint of the unaffected arm is intensive treatment of the affected arm. This study concluded that CIMT are effective to improve upper extremity function in hemiplegic CP, and there is statistically significant difference between pre test & post test test score. Hence, result of the study strongly recommended that further study would need to generalize the results to target population.

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