

Effect of Child friendly Constraint Induced Movement Therapy on unimanual and bimanual function in hemiplegia

Seyed Mohammad Sadegh Hosseini, MSc

Hamedan University of Medical Sciences, Hamedan, Iran

Hossein Sourtiji, MSc*

Esfahan University of Medical Sciences, Esfahan, Iran

Atefeh Taghizadeh, MSc student

Pediatric Neurorehabilitation Research Center, University Social Welfare and Rehabilitation Sciences, Tehran, Iran.

Objectives: Hemiplegia is a non-progressive damage in premature growing brain which causes movement disorders in one side of the body. The objective of present research is to study the method of modified constraints induced movement therapy (CIMT) which can be appropriate on unimanual and bimanual functions of children with Hemiplegia.

Method: This single-blinded, randomized, control trial study performed on twenty-eight participants who were selected based on specific inclusion criteria and divided into two groups of CIMT and conventional therapy. Intervention at CIMT was done six hours every day, for 10 days, whereas another group received conventional occupational therapy.

Results: To analyze the data, independent-sample t-test and paired-sample t-test were used. Results showed that significant differences in variables of unimanual function, Jebson Taylor test and dexterity of involved hand in CIMT group, but, these variables did not show any difference in conventional group. Also bimanual functions in CIMT demonstrated significant difference in variables of bimanual function, bilateral coordination, and caregivers' perception (how much) and (how well), whereas this variables did not show any difference in pre-test and post-test of conventional therapy.

Conclusion: Child friendly CIMT has fairly good effects on unimanual function and some variables of bimanual function of children with hemiplegia.

Keywords: pediatric constraint movement therapy, hemiplegia, bimanual function, unimanual function.

Introduction

One child out of three children who suffer from cerebral palsy is hemiplegic. Hemiplegia is a non-progressive damage in premature growing brain which causes movement disorders in one side of the body (1). Unilateral movement impairments in the involved side have been studied widely, while most of the daily activities are done by two hands (for instance; putting clothes on and opening the door of boxes) (2-4). Therefore, study about the bilateral coordination seems necessary. Some researches have studied the bilateral coordination of children who suffered from cerebral palsy (5-7).

The upper limbs of such children usually show more impaired than their lower limbs including spasticity, sensory problems and decrease of strength. Being involved in effective use of limb to reach, grasp,

release and manipulation have been agreed by the previous performed researches (8). On the other hand, hemiplegic children usually enjoy a normal intelligence quotient (IQ) therefore can study in school beside normal children. But involvement of upper limbs may affect their cooperation in their roles in school and in their future (9). Rehabilitation therapists of upper limbs have used wide range of interventional techniques which are mostly time-consuming and expensive. These interventions consist of behavioral, environmental and physical therapy and utilizing electrophysiology, medical therapy and/or surgery. Among these methods, effectiveness of treatment has had few evidences by conventional occupational therapy and casting (10). However, injecting Botulinum Toxin A adjunct with exercises of upper limbs has displayed some

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* All correspondances to: e-mail: soortigi.ot@gmail.com

improvement in hemiplegic children (11). New approaches suggest that such children should overcome on "learned non-used", since cerebral palsy children have never used their limb correctly. Other studies have investigated constraint induced movement therapy which creates limitation for the non-involved hand of the child and uses structured exercises to increase its function (12). Results of these researches show that constraints induced movement therapy has been effective on improvement of hand function of children (13-15). Also, this approach has been performed for adults and children in various methods. However, utilized activities for adults (such as opening and fastening screw) are not interesting for children, so some modifications should be done for children to become appropriate for play and age-related activities (16-17). As mentioned before, bimanual function and bilateral coordination of such children are very important and we have found just one research which had studied the effect of method of constraints induced movement therapy on bimanual function and bilateral coordination of these children, which shows its effectiveness but have not displayed any result whether these functions can be generalized into natural environment and their life (17).

The objective of present research is to study the method of modified constraints induced movement therapy which can be appropriate for children on unimanual and bimanual functions of children with Hemiplegia.

Method

This research has been performed with single-blinded, randomized, control trial, on 28 participants which are selected based on inclusion criteria and divided in two groups of constraints induced movement therapy (age range of $92 \pm 16/33$) and conventional therapy ($85 \pm 17/51$). Inclusion criteria were: 1. Ability of extension of wrist joint more than 20 degree and fingers in metacarpophalangeal joints at least 10 degree from full flexion. 2. More than 50% difference between involved and non-involved hands in Jebson Taylor Hand Function Test. 3. Ability of rising involved hand from surface of table more than 15 centimeters. 4. Obtaining score at least 70 based on Color Rivian Test of IQ. 5. Willingness to participate in the research. Exclusion criteria include: 1. Health difficulties not related to cerebral palsy. 2. treatment-resistant seizures. 3. Visual problems that would interfere with carrying out the

test. 4. Muscle tone with an average higher than 3.5 in upper limbs based on Modified Ashworth Score. 6. Orthopedic surgery on involved hand. 6. Having rhizotomy in the last one year. 7. Botulonium toxin treatment in muscles of upper limbs in the last six months or during the study. 8. Use of Intrathecal BALEN in the last six months before the intervention or during the study. 9. Balance problems while wearing splint.

Participants have been selected based on stratified random sampling method. In this method, after providing sampling framework, persons based on inclusion and exclusion criteria have been classified in 4 levels, then samples has been selected randomly in two groups.

After that we measured bimanual skills, unimanual function (involved side) by Bruininks-Oseretsky Motor proficiency Test, hand-grip strength by hand-holder dynamometer, active and passive range of motion by goniometer, caregivers' perceptions of how much and how well their child used involved upper extremity by caregiver Functional Use Survey (CFUS), muscle tone by Modified Ashworth Score and tactile perception two point discrimination, and registered the scores of the participants.

Finally, randomly the participants were placed in constraint induced movement therapy and conventional therapy groups. Intervention at constraint induced movement therapy was done 6 hours every day, during 10 days, whereas another group was utilized conventional occupational therapy. After the end of intervention period, dependent variables were measured for the second time and the result were registered and analyzed. Ethical considerations and responsibilities to all participants of this study are defined on basis of codes of ethic committee of university of social welfare and rehabilitation sciences (including 26 articles).

To analysis of statistical data descriptive analysis was done for mean and standard deviation and to compare the mean of dependent variables between two groups, independent-sample t-test was used and in order to compare pre and post mean of each variables within groups, paired-sample t-test was used. Selection of these tests was done because of normal distribution of variables in groups by using Kolmogorov-Smirnovs.

Results

In this study due to beginning school season and being too long session in every day, 3 children failed (2 children in CIMT and 1 in conventional group).

To evaluate the basic data in each group, descriptive test has been used (Table 1). The ratio of boy to girl in CIMT was 6 to 6 and in another one was 7 to 6

and in both groups the number of participant with left involved side was more.

Table 1. demographic information of children participant

Group	Indicator	IQ	Involved hand		Age	Sex	
			Right	Left		Female	Male
CIM Therapy		86.05±1.38	4	8	94±90.1	6	6
Conventional Therapy		81.92±99.9	6	7	85±17.51	6	7

We divided dependent variables in two categories: unimanual activities variables, Jebson Taylor test and dexterity which evaluate unimanual functions were set in one category and bimanual activity variables, upper limb coordination, bilateral coordination and caregivers' perception which evaluate bimanual function were set in another category. As showed in table 2 based on comparison

of pre-test and post-test, significant differences were seen in variables of unimanual function (P=0.008), Jebson Taylor test (P=0.010) and dexterity of involved hand (P=0.012) in CIMT group, but, this variables didn't show any differences in conventional group.

Table 2. comparison of pre-test and post-test means in both groups

Variables	CIMT		Conventional Therapy	
	t	P value	t	P value
Unimanual function(non-involved hand)	-1.000	0.339	-0.643	0.532
Unimanual function (involved hand)	-3.3251	0.008	-0.562	0.584
Jebson-Taylor test (non-involved hand)	0.830	0.424	-0.342	0.738
Jebson-Taylor test (involved hand)	3.119	0.010	0.866	0.403
Dexterity (non-involved hand)	-1.358	0.202	-2.008	0.068
Dexterity (involved hand)	-2.994	0.012	-0.898	0.387
Bimanual function	-3.532	0.005	-0.201	0.844
Bimanual coordination	-2.057	0.064	1.389	0.190
Bilateral coordination	-3.079	0.010	-1.000	0.337
Caregivers' perception (How Much)	-2.912	0.014	-0.401	0.695
Caregivers' perception (How Well)	-3.967	0.002	-0.628	0.542

Evaluation of participants' bimanual functions in CIMT demonstrated significant difference in variables of bimanual function (P=0.005), bilateral coordination (P=0.010), and caregivers' perception (how much, P=0.014) and (how well, P=0.002), whereas this variables didn't show any difference in pre-test and post-test of conventional therapy.

Unimanual functions, variables of unimanual activities of involved side (P=0.021) and dexterity of involved side (P= 0.035) are different, while there wasn't any difference in other variables. There was significant difference between two groups in bimanual function of bimanual activities, upper limb coordination, bilateral coordination and caregivers' perception (P=0.05).

Comparison of mean differences of variables between two groups in table 3 demonstrates changes in unimanual function (P=0.021) and dexterity (P=0.035) of involved hand, while other variables don't show any changes. In bimanual activities,

upper limb coordination, bilateral coordination, caregivers' perception between CIMT and conventional therapy significant differences were seen (P=0.05).

Conclusion

In the study, the effectiveness of using CIMT on manual function of children with hemiplegia is indicated. Improvement was considerably more than conventional therapy. Results of Jebson Taylor and bruininks-oseretsky showed improvement in performance of involved hand. Also CFUS and bruininks-oseretsky demonstrated promotion in bimanual function in interventional group before and after test. Occupational therapy approach which is used in conventional therapy group was neurodevelopmental therapy that was held at two sessions, one hour in a week. The other group underwent 60 hours intensive therapy. Therefore, according to our expectations, intensive therapy has

Table 3. comparison of means differences between two groups

Variables	Means differences	t	P value
Unimanual function (non-involved hand)	1.442	2.468	0.021
Unimanual function (involved hand)	-0.372	-0.436	0.670
Jebson-Taylor test (non-involved hand)	-32.205	-1.758	0.092
Jebson-Taylor test (involved hand)	-6.179	-0.799	0.432
Dexterity (non-involved hand)	1.352	2.300	0.035
Dexterity (involved hand)	-0.096	-0.140	0.890
Bimanual function	2.013	2.804	0.012
Bimanual coordination	1.231	2.267	0.033
Bilateral coordination	0.756	2.689	0.019
Caregivers' perception (How Much)	0.939	3.110	0.005
Caregivers' perception (How Well)	0.878	4.228	0.001

much effect on functional improvement which is similar to previous researches (18).

On the other hand, the used approach in conventional therapy focuses on decreasing of impairment and facilitation of normal movement pattern (19). However, the approach of CIMT relays on principles of motor learning on targeted movement and it may be a priority over conventional therapy.

In CIMT approach, unimanual activities or tasks are utilized and according to former researches, they are able to transfer to bimanual activities and lead to improvement of bimanual function. About two decades have passed from application of CIMT; therefore more research on effectiveness of bimanual function and use of upper limbs in activities of daily living activities should be carried out. Up to now one research is found, which explains the effect of this approach on promotion of bimanual function and bilateral coordination and our research is similar to this study (17).

Because, this approach engages playing and doing

unimanual tasks, this question was posed "Does this approach reduce the function of ability of non-involved hand due to its constraint". Results show that CIMT effects on the non-involved hand function, even if this changes are not significant. The reason of its changes is in using improved involved hand simultaneously with non-involved hand in daily living activity. Therefore, he/she could use bimanual function in daily activities which could not do before, so, this leads to a little improvement in non-involved hand functions. Not only evaluation of bimanual variables confirmed the improvement, but also families experienced reported such improvement. Any related research wasn't found that can be compared.

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