EFFECT OF HAND –ARM BIMANUAL INTENSIVE THERAPY (HABIT) ON UPPER LIMB COORDINATION, SPEED AND DEXTERITY IN CHILDREN WITH HEMIPLEGIC CEREBRAL PALSY

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INTRODUCTION

Children with hemiplegicCerebral palsy (CP) often have impairments in function of the involved upper extremity that affect their hand functions and independence in their daily living skills. They may benefit from intensive unimanual practice or contemporary Occupational Therapy. Constraint-induced (CI) movement therapy is a physical intervention that has been receiving increasing attention in pediatric rehabilitation. So far, the evidence suggests that practice associated with CI therapy may improve impaired unimanual hand function in some children with hemiplegic cerebral palsy (CP). However, CI therapy has several important limitations. Most importantly, children with hemiplegia have impairments in bimanual coordination beyond their unilateral impairments. Thus, an intervention approach to increase functional independence during activities of daily living by using both hands in cooperation is needed.This study uses a recent intervention – HABIT (hand arm bimanual intensive therapy) to address impairments in Upper limb skills, speed and dexterity in Hemiplegic CP.

NEED OF THE STUDY

Hemiplegic CP is the result of early brain damage resulting in movement impairments largely lateralized to one side, with the upper extremity usually more affected then the lower extremity. Often the integrity of the motor cortex and cortico spinal pathways necessary for precision grasping and fine control of the fingers and hand are compromised. Also brain damage associated with hemiplegia often includes areas known to be involved in bimanual coordination such as supplementary motor area and the parietal lobe. Impaired bimanual upper limb coordination might be amenable to treatment. Hence this study implemented a recent advancement in therapy called HABIT (hand arm bimanual intensive therapy) to focus on the upper limb coordination, speed and dexterity in children with hemiplegic CP.

RELATED LITERATURE

During bimanual movements, the non-involved hand could provide a template for the involved hand when movements are either performed sequentially or simultaneously. Although there is some suggestion that initial unimanual practice with the involved hand can transfer to improvements in bimanual coordination, principles of motor learning emphasize the importance of task specificity in practice to maximize learning. Thus, improved bimanual coordination might be best accomplished by practicing bimanual skills directly.Participation in HABIT involves active learning and problem solving for children to discover their bimanual capabilities.

AIM OF THE STUDY

To examine the effect of HABIT on upper limb coordination, speed and dexterity in children with hemiplegic Cerebral Palsy

Method: This study was carried out at NIEPMD (National Institute for the Empowerment of persons with Multiple Disabilities), Muttukadu, Chennai.

Participants: Twenty hemiplegic children (12 boys, 8 girls), between 4 to 9 years with mild to moderate hand involvement participated in this study. The following inclusion criteria were established: 1) ability to extend the wrist greater than 20 degrees and the fingers at the metacarpophalangeal joints greater than 10 degrees. 2) the ability to lift the involved arm from the table surface to a surface six inches above, 3) hand spasticity ranged between 1 and 1 + grades according to the Modified Ashworth Scale participated in the study. Children with moderate and severe spasticity or fixed upper limb deformities or children with moderate, severe and profound Mental retardation were excluded from the study. Subjects were randomly placed into 2 groups equally. Children in the experimental group were given functional activities and therapeutic play that provided structured bimanual practice for 2 hours per day for 12 weeks(5 sessions per week), while subjects in control group received Conventional Occupational Therapy intervention to improve upper-extremity function.

Tools Used: Pretest before intervention and posttest after completion of 12 weeks was performed to all subjects, using the "**Bruininks–Oseretsky Test of Motor Proficiency"** to evaluate Upper Limb Coordination, Speed and Dexterity of the affected upper extremity.This is a standardized test of gross and fine motor function for children to measure changes in hand use.

Procedure: Children in the control group received a unimanual treatment program for the involved upper extremity directed towards improving upper extremity function including weight bearing activities, hand function skills training using therapeutic activities like peg board activity, dough activity, ball bouncing, coloring, placing pennies in a box.

Patients in the study group received HABIT that focuses on 1) provision of structured practice increasing in complexity, 2) provision of functional activities that necessitate bimanual hand use. Children practiced bimanual activities for 2 hours per day for 12 weeks (5 sessions per week). The intervention is conducted in groups to provide an environment of peer support, three to four children in a group.. HABIT retains the two major elements of pediatric CI therapy (intensive structured practice and child-friendliness). The proposed methodology demonstrates that extensive targeted practice can be provided in a child-friendly manner without using a physical restraint. HABIT included Task selection, Practice, Grading- task difficulty and Home practice (1 hour / day). Parents kept activity logs to monitor compliance. This practice began a regular routine of involved-hand use in the child's environment so that parents or caregivers could solve problems with staff members, with the hope that this interface would continue beyond the intervention.

A large bank of age appropriate activities that require use of both hands like manipulative games & tasks, card games, video games, functional tasks, gross motor activities and arts & crafts were established. Specific activities were selected by considering the role of the involved limb in the activity (e.g. stabilizer, manipulator, active/passive assist). Task difficulty is graded as performance improves by requiring greater speed or accuracy, or by providing tasks that require more skilled use of the involved hand and arm from stabilizing to manipulating. Children were given specific instructions about task performance and positive reinforcements were used for motivation. Directions were given to the child before the start of each task in order to specify how each hand would be used during the activity and to avoid use of compensatory strategies (performing the task unimanuallywith the non-involved extremity).

Children were engaged in two types of structured practice during the intervention: whole task and part task practice. During performance of whole task practice, activities were performed continuously for at least 15 to 20 minutes but no longer than 1 hour. Targeted movements and spatial and temporal movement coordination were practiced within the context of completing a task (e.g. playing a board game).

Part task practice involved practicing a targeted movement exclusive of other movements. It is analogous to shaping in psychology and CIMT literature. Repetition of the activity was emphasized. Specifically, symmetrical bimanual movements were often used to elicit a targeted movement (e.g. dropping pennies in a box simultaneously with each hand). The symmetrical task allows children to practice targeted movements (i.e. manipulation and wrist extension) with augmented neural input from the non-involved side.

Results:

Comparison within each group before and after treatment: There was a significant difference in upper limb coordination, speed & dexterity pre and post therapy in control group (p=.000), as given in table 1. In the experiment group as well significant improvement was noted in upper limb coordination, speed & dexterity post HABIT intervention. (p= .000) as shown in table 2

Comparison between groups before & after treatment: Statistically significant difference was recorded between control & study group after therapy intervention (p = .000) , table 3 proving that experimental group subjects showed better improvement than the controls in all variables.

Table 1: Comparison of mean values of different variables measured pre & post therapy intervention in control group. (Using paired t test)

Variable **(Upper limb Coordination)**	**Mean**	**Mean diff**	**Std. Deviation**	**Std. Error Mean**	**t value**	**Sig**
Pre (N=10)	11.3000	3.1000	1.28668	.40689	- 7.619	0.00
Post (N=10)	14.4000					
Variable **(Speed & Dexterity)**						
Pre (N=10)	29.1000	10.1000	1.72884	.54671	-18.474	0.00
Post (N=10)	39.2000					

Table 2: Comparison of mean values of different variables measured pre & post therapy intervention in Experimental group. (Using paired t test)

Variable **(Upper limb Coordination)**	**Mean**	**Mean diff**	**Std. Deviation**	**Std. Error Mean**	**t value**	**Sig**
Pre (N=10)	10.8000	7.1000	1.19722	.37853	18.754	.000
Post (N=10)	17.9000					

Variable	(Speed & Dexterity)						
	Pre (N=10)	25.4000	17.7000	2.83039	.89505	-19.775	.000
	Post(N=10)	43.1000					

Table 3: Comparison of mean values of different variables measured pre & post therapy intervention between Control & Experimental group. (Using un-paired t test)

Upper limb	coordination	Mean	Mean diff	Std. Deviation	Std. Error diff	t value	Sig (2- tailed)
N=10	Control	3.1000	- 4. 0000	1.28668	.55578	- 7.197	.000
N=10	Experimental	7.1000		1.19722			

Speed &	Dexterity						
N=10	Control	10.1000	- 7.6000	1.28668	1.04881	- 7.246	.000
N=10	Experimental	17.7000		1.19722			

Discussion:

The results of the present study proved marked improvement in upper coordination, speed & dexterity in both the control & experimental group. Whereas the experimental group subjects showed better improvement in hand functions with statistical significance than the control in upper limb coordination, speed & dexterity with a mean difference of -4.000 and _ 7.6000 respectively.

Better Improvement in the Bruininks – Oseretsky Test of Motor Proficiency scores in the study group may be attributed to the Hand Arm Bimanual Intensive therapy as supported by M. Abd El Wahab et al in their study who emphasized that HABIT differs from the conventional Occupational Therapy in at least two ways: 1) The intensity of training is far greater, providing sufficient opportunity for practice using principles of motor learning, 2) encouraging the use of the involved hand in any manner as the child was asked to use it as a typically developing child uses their non dominant hand.

As Gordon et al stated in his study, HABIT is complementary to (rather than a substitute for) other treatments of the upper extremity as it only occurs during a short period. Nevertheless HABIT may be performed over a longer period or repeated during

childhood and adolescence. One aspect that does make it easier than CIMT is the fact that bimanual activities are generally more motivating.

HABIT's emphasis on functional activity performance also directly addresses the recent modification of the definition of CP, whereby it is considered a 'disorder of movement and posture causing activity limitation'.

HABIT is more inclusive than CI therapy because the child merely requires residual capabilities to use the affected hand minimally as a passive assist. However, the presence of consistent bimanual hand use before participation may leave little room for improvement. Children must be old enough and cognizant to understand directions and understand why they are participating.

Overall, this intervention showed improved involved upper extremity bimanual function in this select group of children with hemiplegic CP. However, the results are limited in that the sample size was small. Larger studies using stratified randomization across a more diverse participant population with a long-term follow-up are required for future study.

Conclusion:

This study concludes children with Hemiplegic CP will benefit from HABIT intervention better than conventional Occupational therapy intervention in improving upper extremity functions. Although HABIT is designed for children with hemiplegia, it could potentially be applied to other populations where bimanual control is also impaired. Likewise, if it were modified in intensity, it may be suitable for younger children without the potential psychological and physical risks of CI therapy.

Implications of the study:

Hand Arm Bimanual Intensive Therapy has a positive effect on upper extremity motor performance of hemiplegic CP children. Thus upper limb coordination, speed & dexterity might be best accomplished by practicing bimanual skills directly.

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