SHORT REPORT

HABIT training in unilateral spastic cerebral palsy children having mirror movement disorder

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Abstract

The single-arm feasibility study was planned to evaluate the therapeutic effect of hand arm bimanual intensive training in improving the fine and gross motor functions of hand, and in the reduction of intensity with respect to mirror movement disorder. The sample comprised unilateral spastic cerebral palsy children aged 6-16 years who were having mirror movement disorder and were able to make a gross grip. The hand arm bimanual intensive training was provided to the participants for 6 hours per day for 15 days for a total of 90 hours. Comparison of baseline and post-intervention showed that the functional independence level of children had improved, with improvement in unimanual and bimanual hand performance ($p<0.05$). However, there was no improvement seen in the severity of mirror movements ($p>0.05$). Hence, hand arm bimanual intensive training was found to be effective in increasing the functional independence of cerebral palsy children by improving the hand function, but there was no effect on mirror movement disorder.

Keywords: Cerebral palsy, Physical therapy, Mirror movements, Rehabilitation.

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Introduction

Mirror movement disorder (MMD) is a condition in which voluntary movements on one side of the body are mirrored by involuntary movements on the other side. This disorder primarily involves the upper extremity, specifically the hands and fingers. Prevalence of mirror movements is 35.7% in spastic cerebral palsy (CP) children.[1,2] The MMD is present from infancy or early childhood, and usually persists throughout life. Children with unilateral spastic CP having mirror movement disorder face difficulty in performing activities of daily living, particularly those that require unimanual hand function, such as writing or typing. Mirror movements negatively affect the hand performance and functional independence of CP children.[3,4] The underlying mechanism of MMD relates to corticospinal organisation.[4] The brain lesion disrupts the normal crossed corticospinal projections from the lesioned hemisphere, while the contralateral hemisphere preserves its normal transient ipsilateral corticospinal pathway. As a result, the two hands are controlled by the same hemisphere.[5,6]

Hand arm bimanual intensive training (HABIT) is a functional tool that focusses on improving the coordination of two hands using structured task practice involving bimanual hand performance and functional activities.[7] HABIT has proven to be effective in improving upper extremity function and coordination in hemiplegic CP children.[8,9] However, the literature regarding the effect of such training on MMD is limited. The current study was planned to evaluate the therapeutic effect of HABIT in improving the fine and gross motor functions of hand, and in the reduction of MMD intensity.

Methods and Results

The single-arm feasibility study was conducted at Al-Farabi Special Education School, Islamabad, Pakistan, from April to July 2019. After approval from the ethics review committee of the Riphah College of Rehabilitation Sciences, Islamabad, the sample size was calculated using the OpenEpi10 tool. The sample was raised using non-probability purposive sampling technique. Those included were children of either gender aged 6-16 years with mild to moderate spastic hemiplegic CP and having MMD. The MMD diagnosis was based on the Wood and Teuber criteria[2] active wrist extension, thumb abduction and extension of any two digits of 10 degrees. Children with low tone, and ataxic CP, unable to follow instructions, having spasticity of grade 3 and 4 as per the Modified Ashworth Scale, and falling in levels IV and V on manual ability classification scale (MACS) were excluded.[5,6]

After taking permission from the school administration, and written informed consent from the parents of the children, 50 children were assessed. Of them, 9(18%) children met the inclusion criteria. Baseline assessment was

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done in each case. Jebson Taylor hand function test (JTHFT) consists of 7 components; writing a short sentence, turning a card, picking up small common objects, simulated feeding, stacking checkers, picking up large light, and heavy objects. It assesses the fine and gross motor unimanual hand function. Participants performed each task with first non-dominant hand, followed by the dominant hand.[1,3] The score for the component is equal to the time in seconds required to complete the task, and the total score is equal to the sum of points for all components, and it is calculated separately for each hand. The Wood and Teuber criteria[2] measures the mirror movements that consists of three tasks (fist opening and clenching, finger opposition and finger tapping) and five grades, with grade 0=no clear mirror movement, grade 1=barely discernible repetitive movement, grade 2=slight mirror movement or stronger shorter time, grade 3=stronger and sustained mirror movement, and grade 4=mirror movement equal to the opposite hand.

Each task was performed with the participant sitting comfortably with elbows and forearm supported on the table. A video was recorded for all the children while performing the tasks in order to make sure the presence and absence of MMD. Bimanual hand function was assessed with a set of 5 bimanual activities of daily living, including carrying a tray, cutting a fruit with a knife, holding and cutting the paper with scissor, buttoning, and knotting. There are four grades; grade 0=non-existent), grade 1=assisting without grip, grade 2=assisting with alter grip, and grade 3=normal.[6,8] MACS was used to determine the level of functional independence in children. About 30-40 minutes were spent on each child for this assessment.[5]

The participants received HABIT after baseline assessment for 6 hours per day for 15 weekdays (90 hours) in the physiotherapy room of the school, and included a home plan. Each participant was provided the therapy under the supervision of the class teacher by a specialized paediatric physiotherapist and occupational therapist. Different age-appropriate fine and gross motor activities, including bimanual play activities, such as painting, building blocks, picking up coin and card games that elicit general movement of interest, were performed by the participants. Home plan activities were provided to the parents of each child for 15 days, and included drawing, colouring and making crafts. After 15 days of HABIT training, the final assessment was completed for each child with JTHFT, Wood and Teuber criteria, MACS, and a set of bimanual activities of daily living.[9,11]

Of the 9 participants, 6(66.6%) were female and 3(33.3%) were male. The mean age was 11.10±2.42 years. Of the total, 7(77.7%) were left hemiplegic and 2(22.2%) were right hemiplegic. There were 4(44.4%) participants with level III and 5(55.5%) participants with level II in terms of MACS. The highest frequency of mirror movement was seen in those with Wood and Teuber criteria grade 2, while the lowest frequency was in those with grade 1.

Table-1: Comparison of hand function at baseline and post-intervention.

Scales	Mean ranks		*p*-value
	Baseline	After HABIT	
Fist opening and clenching	2.33	1.67	0.196
Finger opposition	2.06	1.89	0.36
Finger tapping	2.12	1.95	0.38
MACS	2.83	1.44	0.01*

HABIT: Hand arm bimanual intensive training MACS: Manual ability classification scale.

Table-2: JTHFT and bimanual activities.

Scales	Mean± standard deviation		p- value
	Baseline	After HABIT	
JTHFT (right)	203.4±2.03	187.6±38.2	0.04*
JTHFT (left)	226.8±43.1	195.7±45.62	0.03*
Bimanual activities	10.55±3.20	13.60±3.27	0.02*JTHFT:

Jebson Taylor hand function test, HABIT: Hand arm bimanual intensive training.

Shapiro Wilk test was applied to check data normality, which indicated non-normal distribution of Wood and Teuber criteria and MACS balues, and normal distribution of JTHFT and bimanual activities. Friedman test was applied for skewed variables, which showed that there was no significant difference in all three tasks of Wood and Teuber criteria ($p>0.05$), while MACS showed there was significant difference in functional independence ($p<0.05$) (Table 1).

Paired t test was applied for JTHFT and bimanual activities, which indicated significant difference in unimanual and bimanual hand function ($p<0.05$) (Table 1).

Findings showed that there was no reduction in MMD intensity through HABIT, but children improved their hand performance and functional independence.

Discussion

All the participants responded well to the intervention, which was probably due to the inclusion of playful activities throughout the sessions. HABIT including lower extremity (HABIT-ILE) targeting bimanual activities of daily living provided for 90 hours decreased the severity of MM in an earlier study.[8] The current only targeted upper extremity, and there was no improvement observed in MMD intensity, while hand performance and functional independence of the participants stoof significantly improved.

A study delivered a therapeutic programme based on bimanual activities to CP children with MMD, and after 3 weeks of rehabilitation training, significant improvement was observed in bimanual performance of the children, but

there was no improvement seen in terms of MMD.[7]

The current study had limitations, such as no follow-up post-HABIT, a small sample size and a short duration. The findings need to be interpreted with caution as rigorous methods were not employed. Future studies should design a specific therapeutic programme to target mirror movements, and different types of CP children should be evaluated for MMD.

Conclusion

HABIT improved the hand performance of children due to which functional independence level got improved, but there was no change in MMD severity.

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JS: Designing, literature review and writing.
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HR: Data collection, analysis and interpretation.