Comparison of classic constraint-induced movement therapy and its modified form on upper extremity motor functions and psychosocial impact in hemiplegic cerebral palsy

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Abstract

A prospective randomised control trial (RCT) was conducted in National Institute of Rehabilitation Medicine (NIRM), Islamabad, on 40 children with hemiplegic cerebral palsy (HCP). Children between the ages of four and 12 years with ipsilateral, bilateral or severely asymmetrical impairments who had wrist extension (20°) and fingers flexion (10°) were included. The outcomes tools, Box and Block Test, Quality of Upper Extremity Skill Test, CP (Quality of Life) and Kid screen were used at baseline, mid- and post-treatment assessment. Both the treatment approaches (CCIMT AND MCIMT) equally improved upper limb motor functions and psychosocial life of the children with HCP. On Quest tool, results of dissociated movement were significant (p=0.021) and on CPQOL tool two domains (participation & physical health and family health) showed significant difference (p=0.042, p=0.025). But no significant difference was noted regarding other domains of the tools. The study concluded that both the treatment approaches (CCIMT AND MCIMT) are effective in enhancing the upper limb motor functions and psychosocial life of children with HCP.

Keywords: Constraint-induced movement therapy, Cerebral palsy, upper extremity.

Introduction

Cerebral palsy (CP) is a group of disorders affecting patient's everlasting movement. In Hemiplegic CP, patients have impairments in one side of their body (decreased range of motion, strength, coordination, and sensation) often affecting their bimanual activities and limit their day-to-day activities.[1] Usually, hemiplegic CP patients receive occupational and physical therapy to increase functional skills.[2] Constraint-induced movement therapy (CIMT) is a new technique to treat hemiplegic patients; it facilitates the use of hemi paretic upper limb through constrains of the unimpaired limb.[3] Classic CIMT (CCIMT) involves the restraint of unimpaired Upper Extremity (UE) with mitt, slings or some other device for 90 percent of the day for 15 consecutive days. The patient engages in six hours of rigorous training of involved UE for 10 to 15 days using a set of tasks involving repeated actions.[3] The Modified CIMT (MCIMT) protocols similarly employs constraining of the sound limb, but there are modifications in the types of constraint, intensity of treatment, and dose of innervations.[4] Literature shows that both CCIMT and MCIMT are effective treatments to improve the UE functions in children with CP. However, there is conflicting evidence about which is more effective. The purpose of this study was to compare the effects of CCIMT with MCIMT on upper limb motor functions.

Methods

This study was registered on October 1, 2018, and the first participant was randomised on October 15, 2018. Data was completed on March 1, 2019. It was a single blinded randomised control trail conducted in the National Institute of Rehabilitation Medicine (NIRM), Islamabad. Patients with hemiplegic CP were randomly divided in Classic Constraint-Induced Movement Therapy (CCIMT) group (n=20) and Modified CIMT (MCIMT) group (n=20). Sample size of 40 participants, 20 in each group, was calculated by open Epitool calculator with 95 % CI, power 80% and ratio of sample size (Group II/Group I),[1] using the primary outcome measure.[5] Written informed consent was assigned by parents of all participants. Four to 12-year-old children with ipsilateral, bilateral or severely asymmetrical impairments who had wrist extension (20°) and fingers flexion (10°) were included. Assessment was done at baseline (0 week), second week and third week of intervention. The outcome tools used were: Box and Block Test (BBT) which measures the gross manual dexterity,[6] QUEST that is used to measure the UL functions,[7] CP (QOL) is used to measure the quality of life for children with CP (including psychological and social life)[8] and Kid screen tool is used to assess the children

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Figure: CONSORT Diagram.
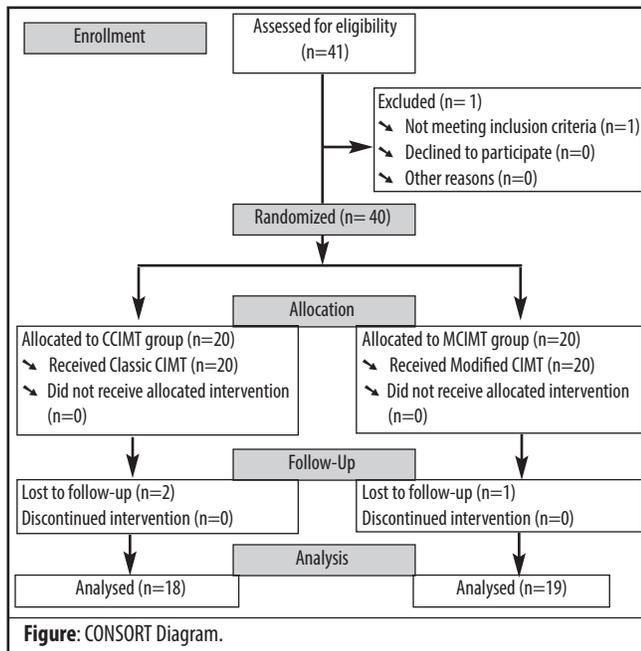
and adolescent's subjective health and well-being.[9] The CCIMT group received daily task practice of impaired limb for six hours a day, five days a week, for three weeks and constraint of unaffected upper limb with mitt or sling for 90% of the waking hours for three weeks.[10] The MCIMT group received the same protocol as the CCIMT group for two weeks, and received daily task training involving both hands for two hours a day, five days per week, for two weeks. Therapy was provided to the children in their home setting. Parents were guided about the timing of restraint and treatment programme. The type of removable constraint used was a mitt that was restraining both the elbow and the hand was constraint by a sling strapped to the trunk. For the convenience of the children's parents, the tasks (similar to daily activities) were given in printed form. The daily tasks to be practiced were reaching activities, grasp, manipulation, releasing activities and weight bearing on UL. The participants' distribution in groups is shown in Figure.

Comparison between CCIMT group and MCIMT group was done through SPSS 21. After applying Shapiro Wilk Test for normality, both parametric and non-parametric tests were applied for within the group and between the group analyses.

Independent sample T-test and Friedman test were applied to check the differences between the two groups and comparison within the group was made by applying the One-Way Repeated Measure ANOVA.

Results

The mean age of the CP children in the CCIMT group was 8.3 ± 0.52 years, while in the MCIMT group it was 7.63 ± 0.49 years. Two children did not continue the treatment plan in the CCIMT group, while in the MCIMT group one child left the treatment due to seizures. There were a total of 37 participants in this study, 17 (46%) males and 20 (54%) females. Group wise gender distribution was 10 males and 8 females in the CCIMT group and 7 males and 12 females in the MCIMT group. There were 5 (27%) left hemiplegic CP and 13 (72%) right hemiplegic CP in the CCIMT group, while the MCIMT group had 12 (63%) right hemiplegic CP and 7(36%) left HCP patients.

Total scores of all outcome measures (Table 1) showed non-significant difference ($p>0.05$) between the groups,

Table-1: The mean, SD and P-values of Box and Block Test (BBT) and Kid screen (Mann Whitney U test), QUEST and CPQOL (Independent Sample T).

Variables	CCIMT Group Mean±SD	MCIMT Group Mean±SD	p-value
BBT(NDH) 0 week	20.2±11.1	12.4±6.2	0.071
BBT(NDH) 2 week	21.3±10.4	15.3±9.2	0.058
BBT(NDH) 3 week	27.3±10.3	20.3±22.4	0.057
BBT(DH) 0 week	41.4±12.4	36.3±12.4	0.169
BBT(DH) 2 week	44.4±13.5	39.4±11.4	0.106
BBT(DH) 3 week	49.5±12.5	44.3±12.3	0.058
QUEST(0 week)	68.3±11.3	69.4±10.2	0.096
QUEST(2nd week)	74.3± 9.07	73.3±8.8	0.087
QUEST(3rd week)	83.4± 8.00	83.3±6.8	0.092
CP (QOL) 0 week	47.4± 6.7	53.4±5.9	0.033
CP (QOL) 2 week	48.5± 6.7	54.2±5.8)	0.021
CP (QOL) 3 week	52.4± 7.5	57.4± 5.6	0.0l9
Kid screen 0 week	65.5±10.5	63.1± 13.1	0.935
Kid screen 2 week	67± 9.9	66±17)	0.692
Kid screen 3 week	76± 8.5	78± 10	0.533

DH: Dominant Hand; NDH: Non Dominant Hand

Table-2: Mean and SD of domains of QUEST at 0 week, 2nd week and 3rd week.

Variables	CCIMT Group Mean±SD	MCIMT Group Mean±SD	p-value
DM at 0 week	70.2±12.3	70.2±12.3	0.064
DM at 2nd week	74.3±10.4	76.4±8.9	0.05
DM at 3rd week	84.3±10.2	90.5±4.7	0.02**
Grasp at 0 week	58.4±10.5	55.6±13.1	0.92
Grasp at 2nd week	59.4±11.4	57.2±11.3	0.68
Grasp at 3rd week	69.4±16.4	70.4±12.4	0.56
WB at 0 week	71.3±17.3	75.4±13.2	0.68
WB at 2nd week	78.3±12.4	79.4±13.5	0.45
WB at 3rd week	87.4±9.4	88.4±7.3	0.34
PE at 0 week	72.3±17.4	71.4±21.4	0.73
PE at 2nd week	78.4±16.4	76.5±19.1	0.56
PE at 3rd week	86.2±9.3	83.2±15.3	0.10

Independent Sample t-test; ** shows the p-vaules (<0.05) of Dissociated Movements at 3rd week: 0.02. DM: Dissociated Movements; WB: Weight Bearing: weight bearing on upper limb in prone position; PE: Protective extension.

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Table-3: Domains of CPQOL of CCIMT and MCIMT groups with p-values.

Variables	CCIMT Mean±SD	MCIMT Mean±SD	p-value
SW at 0 week	56.2±10.3	58.5±12.3	0.616
SW at 2 week	56.3±10.4	59.4±11.4	0.553
SW at 3 week	60.1±11.4	62.3±11.1	0.867
FAF at 0 week	50.2±11.5	56.2±10.4	0.162
FAF at 2 week	51.4±11.4	56.1±10.6	0.287
FAF at 3 week	55.3±11.3	59.2±10.6	0.234
PPH at 0 week	50.4±13.4	58.3±9.6	0.083
PPH at 2 week	50.4±13.1	58.3±9.8	0.083
PPH at 3 week	55.3±12.3	62.1±8.8	0.042**
EWB at 0 week	62.4±7.9	66.2±10.9	0.658
EWB at 2 week	62.4±7.9	66.1±10.9	0.341
EWB at 3 week	65.4±8.1	68.3±9.8	0.310
AS at 0 week	47.2±11.1	57.4±11.5	0.012
AS at 2 week	48.5±10.4	58.4±10.6	0.012
AS at 3 week	52.3±10.4	61.4±8.5	0.012
PID at 0 week	14.4±10.6	19.5±11.9	0.216
PID at 2 week	14.5±10.3	19.2±11.9	0.216
PID at 3 week	14.8±10.4	19.4±11.9	0.216
FH at 0 week	61.3±8.6	67.3±6.2	0.081
FH at 2 week	61.3±8.7	68.4±6.3	0.03**
FH at 3 week	65.4±8.2	70.3±7.2	0.02**

Independent Sample t-test; ** shows the p-values (<0.05) of Participation & physical health at 3rd week: 0.042, Family health at 2nd week and at 3rd week are: 0.03, 0.02 respectively.
SW: Social well-being; FAF: Feelings about functioning; PPH: Participation & physical health
EWB: Emotional wellbeing & self-esteem; AS: Access to services; PID: Pain & impact of disability; FH: Family health.

although within the group analysis showed significant improvement (p<0.05) (Table 2, 3); it showed that both the treatments equally improved the functions of the upper limbs.

Discussion

Overall, the results of this study showed that both treatment approaches are effective, because no statistically significant difference (p>0.05) was observed between the two groups, although within the group analysis showed significant (p<0.05) results. Both the treatments equally improved the functions of UL and had beneficial effects on the psychosocial life of the children.[11] CCIMT is effective in enhancing the dissociated movements (QUEST), participation and physical and family health (CPQOL), while no difference was observed between CCIMT and MCIMT in QUEST (grasp, weight bearing, protective extension), BBT dominant hand, BBT non-dominant hand, and CPQOL.[11] Mean difference of dominant hand of the MCIMT group was greater than that of CCIMT on the third week, which showed that MCIMT is effective in enhancing the manual dexterity of the dominant hand. Leanne Sakzewski used the BBT as secondary outcomes measure in unilateral CP to compare the effect of hybrid (modified) CIMT and standard care, and concluded that both the treatments improve the gross manual dexterity of the affected hand.[12] QUEST was used to see the quality of UL functions. Different domains of QUEST were analysed. There was improvement in dissociated movements between the groups which showed that CCIMT treatment is move effective than MCIMT. But there was no statistical difference in grasp, weight bearing, and protective extension between both the groups.[13] Another study showed that overall mean score of QUEST and Kid screen test improved in both the groups after intervention.[14]

Conclusion

The study concluded that both the treatment approaches can be used to improve the UL motor functions, such as gross movements, manual dexterity, dissociated movements, and psychosocial life of children with hemiplegic CP.

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Conflict of interest: None.

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References

1. Elnaggar RK. Effects of plyometric exercises on muscle-activation strategies and response-capacity to balance threats in children with hemiplegic cerebral palsy. Physiotherapy Theory and Pract 2020: 1-9.
2. Kruijsen-Terpstra AJ, Verschuren O, Ketelaar M, Riedijk L, Gorter JW, Jongmans MJ, et al. Parents' experiences and needs regarding physical and occupational therapy for their young children with cerebral palsy. Res Dev Disabil 2016; 53: 314-22.
3. Gelkop N, Burshtein DG, Lahav A, Brezner A, Al-Oraibi S, Ferre CL, et al. Efficacy of constraint-induced movement therapy and bimanual training in children with hemiplegic cerebral palsy in an educational setting. Phys Occup Ther Paediatr 2015; 35: 24-39.
4. Jain T, Bisen R, Ranade P. Effectiveness Of Modified Constraint-Induced Movement Therapy Compared To Hand-Arm Bimanual Intensive Therapy On Quality Of Upper Extremity Function In Hemiplegic Cerebral Palsy Children-An Experimental Study. National J Integrated Res Med 2021; 12: 45-50.
5. Zafer H, Amjad I, Malik AN, Shaukat E. Effectiveness of constraint induced movement therapy as compared to bimanual therapy in upper motor function outcome in child with hemiplegic cerebral palsy. Pak J Med Sci 2016; 32: 181-4.
6. Araneda R, Ebner-Karestinos D, Paradis J, Saussez G, Friel KM, Gordon AM, et al. Reliability and responsiveness of the Jebsen-Taylor Test of Hand Function and the Box and Block Test for children with cerebral palsy. Dev Med Child Neurol 2019; 61: 1182-8.
7. Yildiz A, Yildiz R, Elbasan B. Trunk control in children with cerebral palsy and its association with upper extremity functions. J Dev Phys Disabil 2018; 30: 669-76.
8. Atasavun Uysal S, Düger T, Elbasan B, Karabulut E, Toylan İ. Reliability and Validity of The Cerebral Palsy Quality of Life Questionnaire in The Turkish Population. Percept Mot Skills 2016; 122: 150-64.
9. Nezu S, Iwasaka H, Saeki K, Obayashi K, Ishizuka R, Goma H, et al. Reliability and validity of Japanese versions of KIDSCREEN-27 and KIDSCREEN-10 questionnaires. Environ Health Prev Med 2016; 21: 154-63.

10. Abdullahi A. Effects of number of repetitions and number of hours of shaping practice during constraint-induced movement therapy: a randomized controlled trial. Neurol Res Int 2018; 2018: 5496408.

11. Tervahauta MH, Girolami G, Øberg G. Efficacy of constraint-induced movement therapy compared with bimanual intensive training in children with unilateral cerebral palsy: a systematic review. Clin Rehabil 2017; 31: 1445-56.

12. Roberts H, Shierk A, Clegg NJ, Baldwin D, Smith L, Yeatts P, et al. Constraint Induced Movement Therapy Camp for Children with Hemiplegic Cerebral Palsy Augmented by Use of an Exoskeleton to Play Games in Virtual Reality. Phys Occup Ther Paediatr 2021; 41: 150-65.

13. de Brito Brandão M, Mancini MC, Vaz DV, Pereira de Melo AP, Fonseca ST. Adapted version of constraint-induced movement therapy promotes functioning in children with cerebral palsy: a randomised controlled trial. Clin Rehabil 2010; 24: 639-47.

14. Ilieva E, Ilieva A. What is the effect of constraint-induced movement therapy on children with unilateral cerebral palsy? A Cochrane Review summary with commentary. Dev Med Child Neurol 2020; 62: 1236-8.