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Effect of Constraint-Induced Movement Therapy Along with Conventional Therapy and Conventional Therapy Alone on Upper Extremity Spasticity in Children with Cerebral Palsy

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[1-4] Conception and design, Collection and assembly of data, [4-6]Analysis and interpretation of the data, [4]Critical revision of the article for important intellectual content, Statistical expertise [1-6]Final approval and guarantor of the article.

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A B S T R A C T

Objective: To evaluate the effect of constraint-induced movement therapy along with conventional therapy and conventional therapy alone on upper extremity spasticity and quality of life in children with cerebral palsy.

Methodology: Quasi experimental study. The research was carried out at Faisal Hospital and Children Hospital & Institute of Child Health in Faisalabad from April, 2022 to July 2022. After informed consent and complete evaluation, individuals who fulfill the inclusion criteria were considered for the study. A sample size of 46 were allocated within two groups with one receiving constraint induced movement therapy along with conventional therapy and other receiving conventional therapy alone three times a week for 4 weeks. The results were assessed at the first (week 0), second (week 2), and fourth (week 4) weeks following therapy using the modified Ashworth scale and the cerebral palsy quality of life questionnaire.

Results: The mean MAS scores (pre-treatment $p > 0.05$) was significantly at the second and fourth weeks following therapy (post treatment $p < 0.05$). Also, at the second and fourth post-treatment readings, (pre-treatment $p > 0.05$) there was a statistically significant improvement in the mean CPQOL scores (post treatment $p < 0.05$)

Conclusion: Both groups were proven efficient in reducing spasticity and demonstrated improvement in quality of life, however substantial improvement in results was reported in CIMT group.

Keywords: Cerebral Palsy, Spasticity, Health related Quality of life, Constraint Induced Movement Therapy, Conventional therapy.

Introduction

Cerebral palsy enunciates an array of irreversible abnormalities of posture and movement that have non-progressive disruptions as their cause that occurred in the antenatal development or immature brain.[1] It is depicted by defective muscle tone, postural abnormalities and movement disorders due to prevalent motor indisposition spastic hemiplegia, spastic diplegia, spastic quadriplegia. Disturbances in perception, cognition, and thinking, interaction and behavior and secondary musculoskeletal problems are the associated motor disorders of CP.[2] The 2.08 cases of CP occur for every 1000 live births, yet the incidence is 70 times more prevalent in newborns that weigh less than 1500 g at birth.[3] Significant contributing risk factors have been recognized in the postpartum, neonatal, and prenatal phases that are associated with cerebral palsy. Several genetic components, birth malformations, maternal pre-eclampsia, birth difficulties, and perinatal stroke are among these causes.[4] Regardless of recognition of the risk factors, 80% of cases are considered idiopathic with no clear cause.[5] Spasticity, dyskinesias such as athetosis, stiffness, apraxia, instability, and hyper-reflexia are the main signs of CP. The

secondary conditions associated with CP are reflected by further complications and multiformities of cerebral palsy. Among them is seizures, respiratory dysfunction, neuromuscular dysfunction, scoliosis, autism, chronic pain, disorders of feeding and mastication, intellectual disabilities, trouble sleeping, hearing and visual impairment along with bowel and bladder disorders.[6] Among kids with Cerebral palsy, the condition that is most frequently pervasive is Spastic Cerebral Palsy. Spasticity affects the whole body, yet, it typically intensifies in the upper limbs when unilateral complicity and lower extremities with bilateral inclusion[7]. Postural issues might result from the thoracic muscles being too tight whilst difficulty in feeding and communication. The elbow pronators, wrist and finger flexors, and shoulder external rotators are the muscles in the upper limbs that exhibit spasticity the most frequently.[8] The intricate maintenance of arm and hand activity in humans involves a number of systems, including the strength of the muscles, synergy, sensation, and sensorimotor control. A central nervous system injury like Cerebral Palsy may have an impact on all of those systems. The vast majority of children with bi - lateral spastic cerebral palsy have restricted hand usage during bimanual activities and have trouble handling objects in daily life.[9] With cerebral palsy, the patterns of upper limb motor inclusion vary depending on the degree of spasticity, the patient's age, and the muscles that are damaged. Adduction, internal rotation contracture of the shoulder, flexion contracture of the elbow, and flexion-pronation contracture of the wrist are a few patterns that are more convincing than others. These issues hinder effective hand grip, release, and precise hand placement.[10] When a youngster is unable to interact, it can be difficult to assess their quality of life. Children with poor motor function, poor intellectual capacity, and excessive parental stress have inferior quality of life, according to parent reports. Emotional and social rehabilitation may improve quality of life in children and people with Cerebral Palsy who report having a handicap in areas such as pain, exhaustion, or despair. By constraining the unaffected one, CIMT a rigorous operational task-oriented technique, aims to improve the use of an upper limb affected by hemiplegic cerebral palsy. This treatment promotes brain remodelling and aids in ignoring the taught non-used phenomena, which results in a long-lasting improvement in the impaired upper limb's function.[11] Conventional physiotherapy including active, passive ROM and stretching, on the other hand, are widely practiced as the rehabilitation of mobility problems in CP by the mainstream medical community.[12] The majority of cerebral palsy patients experience spasticity, which restricts their ability to function and engage in daily activities. MAS is a measurement tool as a primary outcome measure. for clinical assessment of extremities spasticity[13]. The secondary outcome measure is the Cerebral Palsy Quality of Life Questionnaire for Children which is an instrument for measuring quality of life specific to CP [14]. CIMT is a proven method for improving motor functionality in hemiplegic cerebral palsy. However, the function of CIMT in spasticity reduction remained unclear. The rationale of the study is to see how conventional physical therapy with CIMT affects upper extremity spasticity in children with cerebral palsy[15]. The objective of this study is to determine the effect of conventional therapy with and without constraint induced movement therapy on upper extremity spasticity in children with spastic hemiplegic cerebral palsy.

Methodology

This quasi experimental study was performed from April, 2022 to July 2022, after approval by the Institutional Ethics Committee of the Faisal Institute of Health Sciences (FIHS\2022\196), Faisalabad. The research was carried out at Faisal Hospital and Children Hospital & Institute of Child Health Faisalabad, using a non-probability sampling technique of the purposive type. After explaining the research protocol to all respondents' caregivers, informed consent was obtained from caregivers of children of age 4-12 years with spastic hemiplegic cerebral palsy16. A detailed evaluation was carried out prior to initiate the study. Trial Registration ID IRCT20220411054500N1 https://www.irct.ir/trial/62912

A sample size of 46 was determined. With 23 participants within every group i.e CIMT group (Group A) or conventional therapy group (Group B) using the following formula.[17]

Z1-α\2 Level of significance=95%, μ1 Expected mean change in dash score in Group A=6.4, μ2 Expected mean change in dash score in Group B=1.7, δ 1 Expected standard deviation in group A=5.7, δ 2 Expected standard deviation in group B=5.5 Z1-β power of study=80%, n expected sample size in group=23.

Each of the 46 participants was assigned to one of two groups: CIMT group (Group A) (n =23) or conventional therapy group (Group B) (n= 23). Children with age 4-12 years 16 including both genders with diagnosed upper extremity spastic cerebral palsy and minimum grade 1+ on modified Ashworth scale18 were included. Children with Intellectual disability, who had concomitant sight and hearing disabilities, Children with previous six months history of hand surgery, convulsions that were uncontrollable, drastic health complications that were not commonly linked with CP, as well as contractures that limited functional arm and hand use were all ruled out. Both groups were given Baseline treatment with

moist Hot Pack for 10 minutes. Group A received CIMT with conventional therapy including active passive ROM and stretching.

CIMT was given three days per week for 4 weeks in two hours session during which the unaffected arm was restraint and all tasks were completed with the affected arm wrapped in a sling. Activities include card game, building a tower with blocks, tongs pick-up game and pickup coins game.[19]

Group B was given conventional therapy include active passive ROM and stretching three times a week for 4 weeks with each activity having 2 sets of 10 repetitions for a duration of 30 minutes.[20] The outcomes were evaluated by baseline measurement (week 0), at second week (week 2) post treatment and fourth week (week 4) post treatment using modified Ashworth scale[13] and cerebral palsy quality of life questionnaire (CP QOL-Child).[14]

The age and treatment group of the participants were the independent variables of study, while the dependent variables were spasticity and QOL. The data analysis was performed using SPSS version 22. Prior to actually performing inferential statistics, the data was evaluated for normality using skewness, kurtosis, and the Shapiro Wilk test for all outcome variable. Because the data for all primary outcome was nearly normally distributed and the assumptions were met, repeated measures were used. ANOVA was used to assess whether there was a difference in CPQOL intervention period between Groups A and B. To determine the difference between groups, an independent T test was performed for CPQOL within group analysis. Mann Whitney -U test and Friedman test were used for within group analysis to figure out the difference in MAS score at three time points.

Table I : Activities of CIMT.

Activities	Time allocate	Procedure	Frequency
Card game	20 minutes	Child will sit and play a card game involving turning cards.	2 sets of 10 repetitions. 10 minutes rest interval
Building a tower with blocks	20 minutes	Child will sit to work on grasp and release against gravity to stack a tower.	2 sets of 10 repetitions. 10 minutes rest interval
Tongs pick-up game	20 minutes	Child will sit and uses tongs to pick up small objects to fill a container.	2 sets of 10 repetitions. 10 minutes rest interval
Pickup coins game	20 minutes	Child will sit and picks up coins to put into a piggy bank	2 sets of 10 repetitions. 10 minutes rest interval

Results

Table II shows the mean age and gender frequency (percentage) in both groups at baseline.

The Modified Ashworth Scale and CPQOL scores significantly improved at post-treatment readings as compared to the baseline values in both groups A and B ($p = 0.00$) as shown in Table 2. Mean Modified Ashworth Scale scores improved significantly at the 2nd and 4th week post-treatment readings with ($p < 0.05$). Spasticity was significantly reduced at the 2nd and 4th week post-treatment readings ($p < 0.05$). The results showed significant improvement in mean CPQOL scores at the second and fourth weeks in subjects in Group A ($p < 0.05$).

Table II: Descriptive statistics for age and gender in both treatment groups at baseline.

Variable		Group A	Group B
Age in Years (Mean ± SD)		8.00 ±2.646	8.87±2.528
Gender	Male (25)	16(69.6%)	9(39.1%)
	Female (21)	7(30.4%)	14(60.9%)

Discussion

The ongoing quasi experimental study sought to determine for certain if 4 weeks of CIMT in young children who had CP improved spontaneous upper limb use more than conventional therapy with the same duration. All outcome measures showed that the CIMT group improved significantly more than the conventional group. In comparison to the conventional group, the CIMT group demonstrated reduced spasticity, which improved the efficiency of the assisting hand, as well as higher quality of life scores(CPQOL) with subsequent periods of treatment.

All impacts were retained after 4 weeks of follow-up, implying that the therapy had a therapeutically substantial effect even after it had ended. Montero et al. conducted a study that found learned non-use in hemiplegic cerebral palsy. On the healthy side, constraint-induced movement therapy can reverse this phenomenon. The efficacy of this therapeutic interventions on upper extremity performance, daily living activities, as well as quality of life. Constraint-induced movement therapy appears to improve upper extremity motor rehabilitation in patients with hemiplegic cerebral palsy.[21] The current study supports that current constraint-induced movement therapy protocol is helpful in stimulating improved function of the affected limb and quality of life. Yu & Kang used constraint induced movement therapy to study changes in grip strength and daily living activities (ADL) in youngsters with hemiplegic cerebral palsy (CP). The CIMT group improved significantly in hand agility and handgrip on the

Table III: Within Group Comparison for MAS and CPQOL					
Outcome measure	Groups	Baseline value	Week 2	Week 4	p value
		Mean±S.D	Mean±S. D	Mean±S.D	
MAS	Group A	3.35±.647	2.39± .656	1.61±.656	.000
	Group B	3.57±.507	3.22±.600	2.65±.573	.000
Social well Being	Group A	38.48±8.623	57.61±9.619	85.13±9.753	.000
	Group B	34.70±5.660	52.35±8.343	74.30±11.679	0.000
Functioning	Group A	21.48±5.493	43.39±5.483	62.74±6.225	0.000
	Group B	19.00±5.461	32.91±6.928	45.52±11.301	0.000
Participation and health	Group A	46.78±10.396	86.17±9.989	127.35±16.364	0.000
	Group B	42.04±6.779	61.52±19.660	82.65±28.211	0.000
Emotional well-being	Group A	15.74±4.434	28.04±3.971	41.57±5.647	0.000
	Group B	14.09±6.721	23.39±4.031	31.83±5.060	0.000
Accesss to services	Group A	23.09±6.417	41.61±6.430	58.96±7.093	0.000
	Group B	22.17±4.030	33.30±5.130	46.26±8.203	0.000
Pain and bother	Group A	20.57±6.528	38.09±9.312	69.78±32.040	0.000
	Group B	20.35±7.139	31.26±7.313	42.26±9.221	0.000
Family health	Group A	12.96±3.890	24.35±4.108	35.61±4.822	0.000
	Group B	11.35±4.260	19.74±2.320	27.48±4.100	0.000
CPQOL total score	Group A	182.35±32.760	319.70±35.409	481.61±60.520	0.000
	Group B	164.39±28.624	254.26±33.714	350.30±52.858	0.000

Table IV: Between groups comparison for mean change in MAS at Baseline, 2nd week and 4th week.				
Outcome Measure	**Session**	**Group A**	**Group B**	**p value**
MAS	Baseline value	3.35 ±.647	3.57±.507	0.086
	2nd week	2.39±.656	3.22±.600	0.000
	4th week	1.61±.656	2.65±.573	0.000
Social well Being	Baseline value	38.48±8.623	34.70±5.660	0.086
	2nd week	57.61±9.619	52.35±8.343	0.054
	4th week	85.13±9.753	74.30±11.679	0.001
Functioning	Baseline value	21.48±5.493	19.00±5.461	0.132
	2nd week	43.39±5.483	32.91±6.928	0.000
	4th week	62.74±6.225	45.52±11.301	0.000
Participation and health	Baseline value	46.78±10.396	42.04±6.779	0.074
	2nd week	86.17±9.989	61.52±19.660	0.000
	4th week	127.35±16.364	82.65±28.211	0.000
Emotional well-being	Baseline value	15.74±4.434	14.09±6.721	0.330
	2nd week	28.04±3.971	23.39±4.031	0.000
	4th week	41.57±5.647	31.83±5.060	0.000
Access to services	Baseline value	23.09±6.417	22.17±4.030	0.566
	2nd week	41.61±6.430	33.30±5.130	0.000
	4th week	58.96±7.093	46.26±8.203	0.000
Pain and bother	Baseline value	20.57±6.528	20.35±7.139	0.915
	2nd week	38.09±9.312	31.26±7.313	0.008
	4th week	69.78±32.040	42.26±9.221	0.000
Family health	Baseline value	12.96±3.890	11.35±4.260	0.188
	2nd week	24.35±4.108	19.74±2.320	0.000
	4th week	35.61±4.822	27.48±4.100	0.000
CPQOL total score	Baseline value	182.35±32.760	164.39±28.624	0.054
	2nd week	319.70±35.409	254.26±33.714	0.000
	4th week	481.61±60.520	350.30±52.858	0.000

affected side, as well as ADL self-care.[22] The current study found that CIMT improved both qualitative and quantitatively the impulsive use of the upper limb in young children with CP. With CIMT, all primary outcomes demonstrated significant improvements. According to Chen and Lin, one of the most efficacious UL therapies for children with unilateral CP is constraint-induced therapy. The program's design was CIT-specific and volitional for children with unilateral CP. With each successive pattern of intervention, performance began to improve steadily. It was suggested that for youngsters with unilateral CP, a constraint-induced therapy programme was valuable to the motor activity of the affected UL.[23]The current study found that the CIMT group equipped an engaging and challenging setting for the children, who appreciated the play-like treatment and provocative activities, resulting in a decrease in spasticity of the affected limb. Sbaour et al. published a study that found that Constraint-Induced Movement Therapy (CIMT) improved upper limb function in children with spastic hemiplegia. CIMT required non-involved upper extremity restraint as well as intensive practise with the involved upper extremity. The intervention group's upper limb function improved significantly, but the threshold of spasticity did not. [24] However, the current study found that 4 weeks of CIMT caused a significant decrease in upper limb spasticity, which improved the efficacy of the assisting hand. According to Abootalebi and A Khoshnevisan, children who received CIMT did not enhance their capacity to use their hemiplegic hand substantially more than children in the control group who received traditional therapies. However, caregiver reports and clinical observations revealed an increase in frequency of use and quality of movement of more affected limbs.[25] In accordance with the findings of this study, when compared to the conventional group, the CIMT group demonstrated reduced spasticity, which improved the effectiveness of the assisting hand, as well as better results for quality of life (CPQOL) with subsequent periods of therapies. After a month of evaluating the study results, the results showed a significant decrease in spasticity. There is little evidence that CIMT can help reduce spasticity. As an alternative to conventional therapy, a new manoeuvre is introduced for clinicians. Furthermore, all effects were maintained at 4 weeks of follow-up, implying a clinically profound affect even after the therapy was completed. This is the study's distinguishing and innovative feature. The study's limitations were that children were frustrated and irritable because restraint was leading to difficulty in activities. The task required a significant amount of effort to complete.

Future research could focus on the effect of CIMT on spasticity reduction in even younger or older children, as well as the curative effects in children with less arm-hand capacity. In young children with CP, the optimised frequency and magnitude of CIMT should be ascertained in relation to the level of spasticity, the size, and duration of its effects.

Conclusion

CIMT is an effective treatment for enhancing the spontaneous use of the more affected arm and hand in children who have cerebral palsy. With subsequent periods of treatment, the CIMT group demonstrated reduced spasticity, which improved the effectiveness of the assisting hand, as well as higher scores for quality of life (CPQOL). All results were retained after 4 weeks of follow-up, implying that the therapy had a clinically significant impact even after it had ended.

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