ORIGINAL ARTICLE

EFFECTS OF TASK-ORIENTED TRAINING ON WALKING IN CHILDREN WITH CEREBRAL PALSY

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ABSTRACT

Objective: To determine the effects of task-oriented training on walking and balance in children with spastic diplegic Cerebral Palsy (CP).

Material and methods: A randomized control trial (ClinicalTrials.gov ID: NCT04561349) was conducted on 44 CP children. Both male and female children were randomized into experimental groups (Task-oriented training) and control groups (mat activities and range of motion exercises). Children with spasticity ≤ 2, age 4-14 years, who could walk and follow the command, were included. However, children with cognitive impairment, lower limb surgery in the last 6 months, tetraplegic CP were excluded. Children were assessed before and after the intervention. The outcome measures were Gross Motor Function Classification Scale (GMFC), Timed Up and Go (TUG), Functional Walking Test (FWT), and Modified Ashworth scale (MAS).

Results: Out of 38, 53.3% males and 44.7% females with the mean age of 9.3 ± 2.9 years. The experimental group had significant improvement in walking as the p-value for both TUG and FWT was significant after the 6th week ($p < 0.05$) but no significant change in manual muscle testing (MMT) and modified Ashworth scale (MAS) was observed ($P > 0.05$).

Conclusion: It is concluded that both techniques are effective to improve walking and balance in CP children. However, task-oriented training has a significant improvement in walking and balance in spastic CP children.

Keywords: Cerebral Palsy, Cognitive Impairment, Spasticity, Walking.

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INTRODUCTION

"Cerebral palsy" (CP) is a common motor problem in children and it is used to define multiple ailments of movement which result in a number of activity limitations[1]. The greatest cause of motor damage in children is cerebral palsy and motor impairment occurs in about 2 out of 1000 live births[2]. CP refers to the most prevailing motor impairment which occurs at an early age and happens with 1 in 1000 births[3].

Cerebral palsy causes motor and postural impairments thus limiting activity. Movement impairments hinder the child's physical activities of daily life. One of the main objectives while dealing with cerebral palsy children is to improve mobility. Various methods of physiotherapy are required to improve the child's functional status. Evidence from the recent studies indicates the benefits of functional therapeutic approaches for specific tasks on the level of function of cerebral palsy children[4]. Task-oriented training is derived from the science of movement and "motor learning". The fundamental principle behind this approach is the repetition of daily tasks carried out through setting specific goals for specific activities instead of merely emphasizing decreasing the impairment. This training includes performing routine tasks again and again with or without modification in order to improve functional activities. According to research, task-oriented training enables "cortical reorganization" and enhances function[5].

A task-oriented approach comprising of functional activities is the new technique of motor learning. Task-oriented training consists of repetition and practice of motor tasks. These are beneficial for cerebral palsy children as it improves their ability to perform functional tasks which help them in their routine activities. It is effective because it involves the children in therapy and encourages them to perform the tasks[6]. It has been used for multiple rehabilita-

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tion purposes such as balance exercises for equal weight distribution on both lower limbs and walking training practice don't read mill and ground, strength training for the maintenance of muscle mass, and general body exercise for overall fitness and wellbeing[7].In 2017, a study was conducted to evaluate the effect of task-oriented training of lower limbs and its effect on walking and postural stability in cerebral palsy children. It mainly emphasized the strength training of lower limbs during a 40-minute session two times per week for a total of 8 weeks. Functional activities of their daily life were performed. This training resulted in improved Gross Motor Functional Classification scoring and better performance of daily tasks[4]. Motor learning training has brought the rehabilitation technique towards task-centered training from the facilitation and inhibition approach. Task-oriented training helps to improve the functional tasks which are useful in routine activities. It involves the repetition of tasks and serves as a good training method for cerebral palsy children encouraging them to perform functional tasks in an interesting manner[6]. In another research held in 2015, task-oriented training was performed with repetitions and gait training was done on the treadmill. The improvement in walking function in cerebral palsy children was observed which reflected the benefit of a task-oriented approach in cerebral palsy children who have some impairment in walking. The results indicated that task-oriented training has positive impact on functional abilities, balance, and walk-in cerebral palsy children[8]. Task-oriented training was used in a randomized control trial (RCT), focusing on the mobility status of cerebral palsy children. The Control group was given conventional therapy focusing on the improved walk and facilitation of normal movements. The experimental group received task-oriented training (TOT) emphasizing lower limb strengthening along with the practicing of functional tasks. It was found that after the period of 5 weeks, positive changes started to show in Gross Motor Functional Classification scores. Scores for the time up and go(TUG) test also showed that the experimental group took lesser time to complete it. This study supported the time up and go and its positive effects on mobility and balance[9].

Stella Maris et al, found in their study that task-specific training improved the functional outcomes in patients with stroke[10]. In another randomized control trial, task-oriented training was used in cerebral palsy and traumatic brain injury children in order to assess the improvement in their functional level by task-oriented training. It included simple tasks of daily activities such as sitting to standing and stepping up for a period of six weeks. After the intervention, a positive change was observed in balance in the experimental group[11].

In our study, task-oriented training (TOT) of the experimental group included balance and reaching exercises, walking forward-backward and sideways, tandem walking, sitting to stand, throwing and catching the ball in different directions, and carrying an object while walking. Protocol for the control group consisted of conventional mat activities, range of motion (ROM) of all limbs, walking on a treadmill without inclination, walking in parallel bars, and cycling.

Children were encouraged and motivated to complete each step of their treatment. All the subjects were given 30 minutes sessions thrice a week for the duration of 6 weeks.

MATERIALS AND METHODS

This randomized control trial (RCT) (ClinicalTrials.gov ID: NCT04561349) was carried out at Armed Forces Institute of Rehabilitation Medicine (AFIRM) Rawalpindi, Pakistan. This study was approved by Riphah research ethical committee with Ref # Riphah/RCRS/REC/00407. The study duration was six months i.e., August 2018 to January 2019. A sample of 44 cerebral palsy children was equally and randomly divided into experimental and control groups i.e., 22 in each group. A purposive non-probability sampling technique was used. Inclusion criteria were spastic diplegic CP children of age between 4 to 14 years with spasticity scores of 2 or less on the Modified Ashworth scale, who can walk gross motor functional classification scale (GMFCS level 1-3) and can perform different activities on command. Children with cognitive impairment, lower limb surgery in the last 6 months, and tetraplegic cerebral palsy were excluded. Participants were divided equally into Group A (experimental) and Group B(control) groups. Task-oriented training (TOT) was given to the experimental group consisting of different functional tasks for lower limbs to improve balance and walk. These tasks included standing unsupported and reaching in different directions for certain objects placed at a distance from the arm for activation of lower limb muscles, sitting to stand from floor to strengthen muscles of lower limbs, sidestepping, stair climbing, walking on a straight line, tandem walking, walking on inclination, walk and carry a glass filled with water to improve multi-tasking and catching and throwing the ball for better balance. Each task was given for 5 minutes. The child was encouraged to complete the task and was verbally cued during training. Tasks were progressed according to each child's performance. These progressions included increasing the number of repetitions, speed, and switching between the tasks. One hour practice of these tasks was advised as a home plan.

FOLLOWING TREATMENT WAS GIVEN TO THE CONTROL GROUP:

Conventional mat activities and range of motion (ROM) of all limbs, lower limb strengthening and stretching exercises for weak and tightened muscles respectively, walking on a treadmill at speed comfortable for the child with zero inclination, cycling on a stationary or moving bicycle, and parallel bar walking. Each exercise was

performed for 5 minutes. One hour practice of the above exercises and thermotherapy for the spastic muscles was advised for 10 minutes once a day at home. Tools used for data collection were the Modified Ashworth scale (MAS), Gross Motor Function Classification Scale (GMFCS), Timed Up and Go (TUG) test, and Functional Walking Test (FWT).

RESULTS

A total number of 44 subjects were included in our study, out of which 38 remained after dropouts. 20 subjects were included in the experimental group while 18 were in the control group. Among the total participants of the study, 21 were male i-e, 53.3% and 17 were female i-e, 47.3%. The number of male and female participants in the experimental group was 10 and 5 respectively. In the control group, the number of male and female participants was 8 and 10 respectively. The mean age of the subjects was 9.3 ± 2.9 years. Out of 38 subjects, 14 children had a gross motor functional scale (GMFCS) level of 1, 19 children had GMFCS level 2 and 5 children had gross motor functional scale (GMFCS) level 3.

WITHIN GROUP RESULTS

Experimental group (A): Within-group analysis was performed for time up and go test (TUG), functional walking test (FWT), and Manual muscle testing (MMT) at baseline, at 3rd week, and at 6th week. A significant improvement was observed in the time up and go test (TUG), functional walking test (FWT)p-value<0.01. But, no significant changes were seen in Manual muscle testing (MMT) of right and left lower limb p-value > 0.01(Table 1). MAS scoring of the lower limb was also done at baseline, 3rd, and 6th week. P-value was significant for Quadriceps muscle i-e, 0.01and was insignificant for Hamstrings and Calf muscles, i-e, 0.4.

Control group (B): In the control group (group B), analysis was performed for the time up and go test (TUG), functional walking test (FWT), and Manual muscle testing (MMT) at baseline, at 3rd week, and at 6th week. A significant improvement was observed in the functional walking test (FWT) p-value < 0.01. While there is no significant changes were seen in the time up-and-go test (TUG) and Manual muscle testing (MMT) of the right and left lower limb p-value > 0.01(Table 2).MAS scoring had an insignificant P-value, i.e., 0.4 for Quadriceps, 0.4 for Hamstrings, and 0.4 for Calf muscles.

BETWEEN GROUP RESULTS

The balance of participants was assessed by using a score of the time up and go (TUG) test. In groups A and B, the mean ± SD for balance at baseline was 41.3 ± 18.4 and 41.1 ± 21.6 seconds respectively. Mean± SD for balance at 6thweek for group A and group B was 38.6 ± 16.9and 39.8 ± 22 seconds respectively. The mean difference for group A was -2.7 and for group B it was -1.3.

Results showed that in the experimental group time taken to complete the time up and go (TUG) test was decreased after 6 weeks of task-oriented training and the mean difference for the experimental group was more than that of the control group who received conventional physiotherapy treatment. (Table 3). The improvement in

Table 1:Table 1: Within Group Analysis TUG, FWT & MMT GROUP A (n=20)

	Baseline	3rd week	6th week	p-value
	Median (IQR)	Median (IQR)	Median (IQR)	**0.01**
TUG	38.5 (31.3)	39 (31.8)	37 (30.8)	
FWT	10 (6.5)	11 (7.3)	12.5 (5.8)	0.01
MMT LL (RT)	3 (1)	3 (1)	3 (1)	0.75
MMT LL (LT)	3 (1)	3 (1)	3 (1)	0.75

Table 2: Within Group Analysis TUG, FWT & MMT GROUP B (n=18)

	Baseline	3rd week	6th week	p-value
	Median (IQR)	Median (IQR)	Median (IQR)	**0.062**
TUG	37 (38.2)	40 (38)	36 (38)	
FWT	12 (9.2)	12.5 (8)	13.5 (10)	0.03
MMT LL (RT)	3 (1)	3 (1)	3 (1)	0.722
MMT LL (LT)	3 (1)	3 (1)	3 (1)	0.722

Table 3: Mean ± SD of Variables Pre and Post Treatment Between Both Groups

Variables	Assessment	Group A Mean ± SD	Group B Mean ± SD
	At Baseline	41.3 ± 18.4	41.1 ± 21.6
	At 6th week	38.6 ± 16.9	39.8 ± 22
Mean Difference		-2.7	-1.3
	At Baseline	11.8 ± 4.1	12.8 ± 4.6
	At 6th week	13.6 ± 3.7	13.7 ± 4.8
Mean Difference		1.8	0.9

functional walking ability was assessed by using scores of the functional walking test (FWT). In group A and group B, the mean ± SD for functional walking ability at baseline was 11.8 ± 4.1 and 12.8 ± 4.6 respectively, and mean ± SD for walking ability at 6th week for group A and group B was 13.6 ± 3.7 and 13.7 ± 4.8 respectively. The mean difference of walking ability for group A and group B was 1.8 and 0.9 respectively (Table 3).

The results showed that there was more improvement in walking ability in the participants of the experimental group than that of the control group as the mean difference of the scores of the functional walking test (FWT) of group A was greater than that of group B.

DISCUSSION

The purpose of this study was to prove the effects of task-oriented training (TOT) on spastic cerebral palsy children by assessing the subjects through the time up and go test (TUG) and functional walking test(FWT). Moreover, this research was conducted in order to explore an intervention that will eventually help to overcome the deficits in balance and walk of cerebral palsy children.

In 2016 MK Franklin Shaju conducted a study to evaluate the effectiveness of task-oriented training on balance and spasticity in children with a spastic type of diplegic cerebral palsy. It was a randomized control trial to compare task-oriented training and conventional physiotherapy over the intervention period of 6 weeks. Scales used for balance and mobility assessment were the time up and go test and Pediatric Balance Scale (PBS) respectively. The mean difference of pre and post-intervention between the two groups was 18.1 and SD was 4.59[6]. The task-oriented training program conducted for 26 CP children for 15 weeks showed improvement on Pediatric Balance Scale (PBS)where results were significant ($P<0.05$)[12]. Similarly, a study done in 2009 by Salem et al. for an intervention period of 5 weeks and a sample size of 10 cerebral palsy children showed that the time taken by the subjects of experimental reduced to complete the time up and go test after task-oriented training. The P-value for the time up and go test came out to be significant, i-e $P=0.017$[9]. These findings were somehow in line with our outcomes. On the 6th week of intervention, there was a decrease in time taken by the participants of both groups to complete the time up-and-go test which was used to assess the improvement in the balance of the subjects. However, group A showed more decrease in the time taken to complete the test. But the p-value was not significant for the outcome as the time period for intervention was only 6 weeks.

Research conducted in Korea (2016) by Hyun-Kyung Han et al found the effectiveness of task-oriented training on “gross motor function measure, balance and gait function” in cerebral palsy children. This RCT study consisted of 24 subjects who were given intervention over the period of 4 weeks. The functional gait outcomes of the task-oriented training group had more scores for the Functional Gait Index than that of the control group. After 4 weeks of treatment, the difference of Mean ± SD between pre and post-treatment was 15.25±10.25 for experimental and 4.42±5.26 for the control group. Therefore, it can be clearly seen that subjects who received task-oriented training had much improved functional gait after the treatment as compared with the control group who were given conventional therapy (including neurodevelopment treatment)[8]. Task-oriented training was used to find its effects on functional ability in CP children. Mobility Assessment Scale and Five-Time Sit to Stand Test were used for evaluation. Significant results were seen in the task-oriented training group ($P=0.03$) after 6 weeks of training[13]. In the current study, 38 subjects were reported with cerebral palsy and treated with task-oriented training over the period of 6 weeks. The task-oriented training group showed more improvement as compared to the control group. So, the task-orientated training showed more improvement in balance and walking in patients with cerebral palsy.

In another research after activity-focused physiotherapy, there was an improvement in gross motor functional GMFM-66 scores (mean=3.8) and also in the Mobility dimension of the PEDI scale, the mean difference (SD) came out to be 2.3 (3.8)[4]. In 2017 a study was conducted to observe the effects of task-oriented training on mobility and posture. It was found that after 8 weeks of intervention gross motor functional GMFM scoring for walking and standing improved and significant results ($p<0.05$) we obtained. Gross motor functional GMFM scores for pre and

post-intervention were 56.34±18.86 and 59.81±17.76[4]. This finding supports the results of our study. After the completion of the 6th week, functional walking of the CP children was improved in both groups. However, the improvements seen in functional walking test scores of experimental groups after task-oriented training were more than that of conventional therapy given to the control group. There was an increase in the mean and standard deviation groups. Mean ± SD for the experimental group for functional walking was 11.8±4.1 at baseline and 13.6 ± 3.7 at week 6 whereas for the control group it was 12.8 ± 4.6 at baseline and 13.7 ± 4.8 at 6th week. Thus, it indicates that the functional walking improvement after the task-oriented training was much better than that of the conventional physiotherapy treatment. Difficulty in gaining attention, non-cooperation, and loss of follow-up due to health issues were the main limitation of our study.

CONCLUSION

It is concluded that both techniques are effective to improve walking and balance in cerebral palsy children. However, task-oriented training has a significant improvement in walking and balances in spastic cerebral palsy children. Specific digital parameters should be used to assess gait patterns and concern muscles of walking. More participants should be recruited for better comparison. Effect of nutrition should also be asses on mobility and balance as nutrition plays an important role in the health of CP participants.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Tariq M:	Concept, Design, and Proofreading
Rafique N:	Acquisition and critical review
Aftab A:	Analysis and interpretation of data
Rafique A:	Data collection, Final approval
Altaf S:	Acquisition and critical review

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.