Effect of Task Specific Circuit Training on Gait and Functional Mobility among Spastic Diplegic Cerebral Palsy

Shruthi J¹, Jagatheesan Alagesan², Senthil Kumar N³, Iswarya S⁴

¹¹Post Graduate, ²²Professor & Principal, ³³Assistant Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical sciences, Chennai, Tamil Nadu, India.

How to cite this article: Shruthi J, Jagatheesan Alagesan, Senthil Kumar N et. al. Effect of Task Specific Circuit Training on Gait and Functional Mobility among Spastic Diplegic Cerebral Palsy. Indian Journal of Physiotherapy and Occupational Therapy / Volume 18, Year 2024.

Abstract

Background and Need for the Study: Spastic diplegic cerebral palsy is the most prevalent and common form of the cerebral palsy. Gait, balance, and coordination are all negatively impacted because it mostly affects the bilateral lower extremities.

Purpose of the Study: The purpose of the research was to find out the effectiveness of task specific circuit training on gait and functional mobility in children with spastic diplegic cerebral palsy.

Methods: In this research, selected 30 children according to inclusion and exclusion criteria. All the Children participating in the study were separated into two groups, Task specific circuit training group and Conventional group, children’s parents were explained about the safety and procedure. Inform assent was provided to the children’s parents after explaining about the intervention and study procedure.

Results: Pre-test measurements and Post-test measurements of the gait and functional independence, assessed using the Edinburgh visual gait scale (EVGS) and GMFM-88. Paired t-test and unpaired t-tests were used for calculating the mean and standard deviation.

Conclusion: The research eventually reached the conclusion that task-specific circuit training is an efficient method for improving gait and functional mobility when used in conjunction with regular physiotherapy.

Keywords: Functional independence, GMFM-88, Cerebral palsy.

Introduction

A neurological disorder known as the cerebral palsy (CP) is characterized by abnormalities in tone, posture, mobility. Based on primary motor ability, it is split Clinically into types: spastic hemiplegia, spastic quadriplegia, and spastic diplegia and dyskinetic and ataxic cerebral palsy. Mostly CP occurs due to damage to the neonatal or fetal brain. Cerebral palsy occurs postnatally and is caused by brain damage that occurs after the neonatal phase but before the age of five. TBI, meningitis, near drowning experience are some common causes for postnatal cerebral palsy. CP refers to a collection of impairments that is permanent which causes abnormal Motion and posture-related patterns that limit activities and are the outcome of non-progressive issues with fetal or infant brain development. Early diagnosis and

Corresponding Author: Jagatheesan Alagesan, Principal & Professor, Saveetha college of physiotherapy, Saveetha Institute of Medical and Technical Sciences.

E-mail: jagatheesanphd@gmail.com
intervention are crucial to providing appropriate medical and therapeutic support to children with cerebral palsy, as it can help better their overall functioning and standard of life. Physiotherapy is an important part of CP rehabilitation since it helps to correct gait and improve walking ability by strengthening muscles. 

Spastic cerebral palsy is classified as spastic diplegia, spastic quadriplegia, or spastic hemiplegia. Among all the other types, spastic diplegic CP occurs more commonly. With appropriate treatment and support, many individuals with spastic diplegic CP can lead fulfilling lives and achieve significant functional improvements. Spastic diplegic cerebral palsy affects primarily both lower limbs. Although the symptoms of spastic diplegic cerebral palsy are like those of other types of cerebral palsy, the following characteristics are more prominent in spastic diplegic cerebral palsy: stiff and tight leg muscles, increased reflexes in the lower limbs, and scissoring gait. CP children who are ambulatory exhibit a variety of abnormal gaits. Spastic diplegic children may exhibit a recognisable walking pattern known as a “scissoring gait” Due to the increased muscle tone, the legs cross over one another when you walk. Children with spastic cerebral palsy typically walk without restriction, but most of them have a deformed gait that includes abnormalities such as crouch gait, walking in toes, knees flexed. In spastic diplegic cerebral palsy, true equinus, apparent equinus, crouch gait, and jump knee are the common gait pattern observed. To provide targeted and effective gait rehabilitation identifying the most impaired gait is important. Performing daily living tasks without anyone’s direct support and ensuring individuals full participation in daily life activities. Cerebral palsy children find difficulty in performing daily life activities. Task-specific circuit training consists of a set of goal-oriented tasks and activities which aims in improving overall functional independence and gait. Task-specific circuit training (TSCT) is an exercise training technique that can be employed to improve walking patterns. Circuit training technique involves exercises that are performed in stations with a pre-planned number of repetitions for a set of duration. It is an approach for training aerobic capacity. TSCT focuses on developing the neural plasticity in CNS and in the tasks are performed with several repetitions of tasks, which aids the children in performing the motor tasks by adapting to different circumstances of daily life.

The GMFM-88, the original version of the test, consists of 88 items that have been divided into five categories according to gross motor function: sitting, crawling, walking, running, and leaping. Numerous articles have used the Gross motor scale to evaluate the efficacy of therapies for CP kids because it enables measurement of motor function. Numerous studies have established the Edinburgh visual gait score (EVGS) as a on point and reliable quantitative OGA scale with good reliability, good validity with other gait assessments, and it is an effective tool to detect changes following physiotherapy. It can be used by experienced and non-experienced observers. The EVGS has a high level of reliability and is a valuable technique used for the overall pathological assessment of CP patients as well as educational purposes using observational gait analysis. EVGS analyses gait pattern through visual gait analysis through video, coronal and sagittal planes were analysed for each lower limb. The study focuses on the effect and improvement in spastic diplegic children on gait and functional mobility post the TSCT intervention. It is essential to understand how TSCT influences walking gait and functional movement in people with spastic diplegic CP in order to improve long-term outcomes and optimize treatment plans.

**AIM**

The aim of the research was to find out the effectiveness of task specific circuit training on gait and functional mobility in children with spastic diplegic cerebral palsy.

**Materials and Methods**

The study has been conducted with an experimental design from February 2022 to April 2023, and sample collection began in July 2022 and therefore carried with treatment period of 8 weeks. The study was conducted in a private hospital in Chennai. Informed assent was provided and parents’ consent was obtained for the child’s participation in the study. Ethical approval was obtained from a private college and the college’s ethical committee approved the research to be performed on humans.
Selection of the samples were based on the inclusion and exclusion criteria and 30 children were finalized. All the children participating in the study treatment program were selected after assessing them using the functional mobility scale (FMS) and children with grades 5, 6 were included in the study. Children who participated in the study were divided randomly into two groups TSCT group and conventional group using concealed envelope method.

**Inclusion Criteria**

Children with both gender, Ages between 9 and 14 years, Functional mobility scale (FMS) grade -5, grade – 6, All Ambulatory spastic diplegic cerebral palsy patients were included in the study.

**Exclusion Criteria**

Uncontrollable seizure, had received nerve block or orthopedic surgery, having hip and knee flexion contracture, Children with True equinus, apparent equinus, and jumping gait were excluded from the study.

**Outcome Measures**

**Edinburgh Visual Gait Score:**

The EVGS was developed and created to visually assess the deviations in gait for children with ambulatory CP. There are 17 observational parameters for each lower limb which will be scored on a three-point scale. The maximum total score is 34 for each lower extremity and values lesser to maximum value indicates lesser deviation.

**Gross Motor Functional Measure (Gmfm-88):**

It is an assessment tool used to measure the changes in CP. The GMFM-88 has many more components which describe and assess each gross motor function separately. As my study focuses particularly on functional mobility and gait, ITEM -E from GMFM-88 will be used as an outcome measure in the study.

**Procedure:**

Selection of the samples were based on the inclusion and exclusion criteria and 30 children were finalized. All the children participating in the study treatment program were selected after assessing them using the functional mobility scale (FMS) and children with grades 5, 6 were included in the study. Children who engaged in the study were categorized into either unit TSCT and conventional. The intervention was provided for about 8 weeks (about 2 months), before the treatment pretest measurements were taken, and after the completion of 8 weeks (about 2 months) of intervention. Post-test measurements were taken. Pretest measurements and post-test measurements of the gait parameters and functional mobility were measured using the EVGS and GMFM-88. In accordance with the norms 30 children had been selected and they were categorized into Task specific circuit training group which consisted of 15 children and conventional group which consisted of 15 children.

**Task Specific Circuit Training (Tsct)**

TSCT consists of a set of activities they are as follows treadmill training, and cycling given for 15 mins, followed by 1 set of straight leg raises and squats were made to perform which consists of a repetitions of 15 and then the patient was made perform tandem walking for 5 minutes and one leg standing for each leg was carried separately for a time period of 6mins, one leg standing on foam for each leg carried out for a period of 4 minutes and then the children were made to walk on different surfaces includes walking on sand, trails, grass and turf, asphalt, and cement for 5 mins and finally staircase climbing, standing on balance board, walking on the obstacle were also performed by the children’s. A total of 45 minutes was given for task-specific circuit training and before the task-specific training warm-up exercises (ankle toe movements, stretching for limb, jumps) were given for 5mins. Total intervention time:50 minutes.

**Conventional Group**

The conventional group received traditional physiotherapy which includes passive stretching for the lower limb, strengthening exercises concentrating lower limb and core muscles, positioning, weight-bearing, and gait training using a parallel bar given for 50 minutes.
Materials Required:
Treadmill, cycle, balance board, standing foam, wedge, bolster.

Data Analysis and Results
Paired t-test and unpaired t-test were used for calculating the mean and standard deviation. To analyse pre and post-test measurements within the group paired t-test was used. Unpaired t-test was used to analyze pre and post measurements between groups. The P value of <0.0001 was deemed statistically significant.

Graph 1 Pre-test and Post-test values of both TSCT group and Conventional group Using EVGS

Graph 2 Pre-test and Post-test values of both TSCT group and Conventional group using the GMFM-88

Graph-1
Shows the pretest and post-test values of both TSCT and Conventional groups using the EVGS. Pretest mean value was 29.07 and post-test mean value was 17.47 for the Task specific circuit training group using the outcome measure EVGS. Pretest mean value was 27.93 and post-test mean value was 23.13 for conventional groups using the outcome measure EVGS. Considering the EVGS lesser the score to the maximum score 34 the lesser will be the deviations and impairments. The P value was <0.0001 and considered to be statistically significant.

Graph-2
Shows the pretest and post-test values of both TSCT and Conventional groups using the GMFM-88(ITEM-E). Pretest mean value was 38.00 and post-
test mean value was 64.67 for the TSCT group using the outcome measure GMFM-88(ITEM-E). Pretest mean value was 35.87 and post-test mean value was 51.67 for conventional groups using the outcome measure GMFM-88(ITEM-E). The p value was <0.0001 and considered to be statistically significant.

Graph 3: Pre-test values of both TSCT and Conventional group using both EVGS and GMFM-88(ITEM-E)

Graph 4: Post-test values of both TSCT group and Conventional group EVGS and GMFM-88(ITEM-E)

Graph-3

Shows the pre-test values of both TSCT and Conventional groups using the outcome measures EVGS and GMFM-88(ITEM-E).

The pre-test mean value was 29.07 for TSCT and Pre-test mean value for conventional group was 27.93 using the EVGS. P-value was 0.3397 and the results are considered statistically significant. The Pre-test mean value was 38.00 for TSCT and Pre-test mean value for conventional group was 35.87 using the GMFM-88(ITEM-E). P-value was 0.2860 and the results are not statistically significant.
Graph -4

Shows the post- test values of both TSCT and conventional group using the EVGS and GMFM-88 as outcome measures.

The post-test was 17.47 for TSCT and for conventional group was 23.13 using the EVGS. The results were statistically significant with p-value <0.05. The post-test mean value was 64.67 for TSCT and post-test mean value for the conventional group was 51.67 using the GMFM-88(ITEM-E). The P value was <0.0001 and considered to be statistically significant.

Discussion

The study’s main target was to detect the effect of TSCT on improving gait and overall movement participation in spastic diplegic CP children. In 2022, Zai et al., W conducted a systematic review on the impact of activity driven learning on kids with CP, mobility performance, equilibrium, and routine duties. The meta-analysis was carried out using RevMan5.4 software, and the methodological caliber of the included publications was assessed. To establish a more reliable scientific foundation for the adoption of TOT in clinical practice, only a few studies of poor quality were included; there is the demand for high quality RCTs.

In 2021 Liang X et al., conducted a meta-analysis in which the exercise therapy’s impact on patients’ movement ability, ambulatory velocity and power was evaluated in individuals with CP. The review stated task-specific circuit training as an intervention for spastic diplegic cerebral palsy children helps in the overall enhancement of functional mobility.

In 2021 Lee NY et al., conducted an experimental investigation to see how in kids with spastic diplegia, double activity regime may enhance equilibrium and agility. In this study, 14 children with spastic diplegia took part. The outcomes of the investigation indicate that kids with spastic diplegia benefit from dual-task exercises in terms of balance and gross motor skills and suitable therapeutic approach for children with spastic diplegia.

In 2020 Han YG, Yun C, conducted a meta-analysis in which eight studies were included with 179 participants participating. The study’s results showed that cerebral palsy patients who trained on a treadmill saw improvements in their endurance, velocity, and limb support period. But the step length and cadence are clinically insufficient.

In 2018, Qurat-ul-Ain AN et al., have conducted a study on a stroke survivor’s gait characteristics and mobility after dependent on the task circuit practice. The study found that task-specific circuit training enhances mobility and gait metrics. Gait and mobility are both improved by performing certain tasks associated with balance and gait in a circuitous approach.

In 2017 Kim JH conducted research into the impact of task-based training on the mobility function and postural stability of those with cerebral palsy children. This study demonstrates that successful and practical Children with cerebral palsy can strengthen their lower limbs over the course of an eight-week task-oriented training program to improve their mobility function and postural stability.

In 2016 Han HK et al., conducted an investigation to assess the impact on gait, balance, and gross motor function in cerebral palsy patients. The GMFM, ambulation and equilibrium capacities in CP were examined in this trial to determine how task-oriented training affected them. The study came to the conclusion that activity based instruction, walking, and movement ability can help people with CP.

In 2016 MK Franklin Shaju et al., examined task-oriented training’s influence on spastic diplegic CP’s balance and movement through research. Studies have demonstrated that activity-based instruction and regular regime were beneficial in enhancing the children with spastic diplegia’s equilibrium and coordination. Comparing the two groups, compared to the traditional physiotherapy group, the task-based exercise group had greater improvement in mobility and balance.

In 2015 Mansoor Rahman, et al., conducted a pilot study to determine how a circuit training program affected the functional abilities of children with CP who are spastic. The study found that the circuit training used in this study helped children with spastic cerebral palsy improve their standing, leaping, walking, and running abilities.
In 2013, Kumban W et al., implemented an experiment to see how task-specific training affected the functional abilities of kids who have cerebral palsy that is mild to moderate. According to the study, children with cerebral palsy function more successfully when task-specific training is paired with traditional gait training.

This study concentrated on improving the gait pattern and encouraging efficient walking in CP children. Spastic diplegic CP children tend to have better improvement with efficient training compared to the other types. Task-specific circuit training as an intervention for spastic diplegic cerebral palsy children helps in the overall enhancement of functional mobility, thus helping the children to perform daily life activities efficiently.

**Conclusion**

The study’s findings suggest that task-specific circuit training, when combined with routine physiotherapy, is an effective strategy for enhancing gait and functional mobility. The findings of this study suggest that task-specific circuit training can help children with spastic diplegia and cerebral palsy improve their ability to move, gait and benefit from TSCT by having better overall performance and standard of life.

**Ethical clearance:** This study was performed in line with the principles of the declaration of Helsinki. Before recruiting the first participant for the study, the study proposal was submitted to the institutional scientific review board committee for approval. The Saveetha College of Physiotherapy, ethical committee approved the research to be performed on humans after ensuring that it followed all applicable national laws and institutional norms (ISRBNo-01/048/2022/ ISRB/PGCSR/SCPT).

**Funding:** The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

**Conflict of interest:** Nil

**Reference**


