

Effectiveness of Spider Cage Therapy for Balance Control in Spastic Diplegic Cerebral Children: A Pilot Study

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Abstract

Background: Spastic diplegic cerebral palsy (CP), a neurological disorder that specifically affects the lower extremities, affects mobility and posture. People with spastic diplegia frequently have balance problems, which reduces their functional independence and raises their risk of falling. In order to treat balance impairments in this population.

Purpose: The aim of the study is to examine novel and alternative treatment approaches that may possibly enhance the motor function and general quality of life in spastic diplegic cerebral palsy children by examining the efficacy of spider cage therapy for balance control.

Methods: 10 children with spastic diplegic cerebral palsy were allocated into developmental and experimental group. The experimental group (n=5) received spider cage therapy and the developmental group (n=5) received conventional physiotherapy.

Result: This finding shows that the conventional group pre and post-test values by using GMFM (30.2±1.67, 34.95±1.58) experimental group pre & post value of GMFM (30.55±5.63, 36.95±1.64) with p value <0.0001. Conventional group pre & post-test values by using PBS (9.2±3.11, 14.95±4.52) and experimental group pre and post-test values of PBS (9.75±1.58, 16.7±1.78) with a p value <0.0001.

Conclusion: The study's findings suggest that children with spastic diplegia might benefit from balance training in a spider cage.

Key words: Spider cage, Exercise, Balance, Suit therapy, Cerebral palsy.

Introduction

A neurological condition called cerebral palsy (CP) affects how people move and how they stand, which can be quite difficult for those who have it. Spastic diplegic cerebral palsy is one of the several subtypes and is characterized by increased muscle tone, primarily in the lower limbs, which impairs

mobility and balance. To improve functional independence and lower the risk of falling, it is essential to treat balance deficiencies in people with spastic diplegic cerebral palsy⁽¹⁾. Although precise figures are unavailable in India, the Indian Paediatric Society estimates that the incidence of cerebral palsy ranges from 2.5 and 3 per 1,000 live births^(2,3). It is the

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single most frequent reason for children's mobility problems. Children with CP may experience severe muscle deficits such as stiffness, muscle weakness, and a lack of selective motor function. The link among spasticity, endurance, and functioning in CP patients is the subject of numerous theories. (3) Reduced muscular strength, range of motion, motor control, sensory organization, cognition, multisensory integration, and abnormal muscle tone can all lead to balance disturbances on a variety of levels. (4) Exercise can assist patients with CP live healthier lives by reducing a variety of secondary diseases and enhancing posture, muscular tone, and balance. The main characteristics of CP are aberrant gross and fine motor organization and function, suggesting improper motor control. Loss of selective motor control, aberrant muscle tone, and imbalance in the strength of the muscles that act as agonists and antagonists, and compromised body balancing processes can all lead to diminished muscle elasticity, decreased joint range of motion, and altered bone and joint development. Limits and balance impairment were a result of individual factors relating to the numerous processes involved. Poor control of balance is one of the key causes of movement issues given the importance of steady management in all measures. The visual, proprioceptive, vestibular, and other higher-level premotor systems, which are essential for achieving balance, are influenced by many different body systems. The balance system's functional aims are to support some voluntary acts, such as posture evolution, posture maintenance, such as sitting or standing, and equilibrium restoration following external issues, such as a slip or self-inflicted instability. (5) Exercises like resistance training and aerobics have been demonstrated to reduce HbA1C levels, which help to lessen the signs and symptoms of diabetic neuropathy⁶. The youngster cannot adjust shifting, which limits their capacity to walk freely, increases gait cost efficiency, and results in early fatigue, making it difficult to start an activity. (6) The various interconnected systems at work are tied to specific causes of impairment and balance issues. Insufficiencies in movement range, motor control, strength of muscles, cognition, sensory firmness, sensory integration, and aberrant muscle tone are some of the factors that contribute to balance disorders on different levels. (7) A promising treatment option for

balance control issues in people with spastic diplegic cerebral palsy is spider cage therapy, a relatively new therapeutic strategy. In this ground-breaking intervention, people are suspended in a specially made harness that is connected to bungee cords in order to provide dynamic support and facilitate functional motions. Spider Cage Therapy may have the ability to improve proprioceptive feedback and postural changes, hence enhancing balance control in this population by providing an immersive and participatory therapeutic environment. (8) The Advanced Spider Suit is a dynamic orthotic that consists of knee pads, knee shorts, a vest, and elastic band caps. The Advanced Spider Suit's main goal is to create a framework of support that will allow the body to be as aligned to normal as possible. This will allow the wearer to regain optimal postural alignment and weight bearing, which is essential for regaining muscle tone, sensory function, and vestibular function. (9)

AIM

To determine the effect of spider cage therapy for balance control in spastic diplegic cerebral palsy children.

Method and Material

The subjects were selected from Saveetha institute of medical and technical sciences (SMCH) with a sample size of 10 and divided in two groups. Informed consent was obtained from parents. The experimental group (n=5) got spider cage therapy and the other group (n=5) received developmental physiotherapy. 10 patients with cerebral palsy among the ages of 4 and 10 were selected and split into the developmental group and the experimental group. All these participants underwent a Gross Motor Function Measure evaluation.

Study Period: From June 2021 to June 2022.

Inclusion criteria

Selection criteria were

- cerebral palsy has been identified in children.
- The gross motor function of children between the ages of 4 and 10 ranges from Levels III to V.

Exclusion standards:

- Hip subluxation or dislocation in excess of 33%.
- Scoliosis of more than 25 degrees.
- uncontrollable seizures, challenging systemic conditions, and high blood pressure.
- injection of botulinum toxin-A within three months of an earlier study.

Outcome measures:**Gross motor function measure scale (GMGM):**

The gross motor function measure scale (GMGM) is numerical gauging of CP from five months to sixteen years old. It has 88 components that quantify five elements of gross motor function. 0 - Does not begin the task, Starts the project (less than 10%), finishes it in part (10–99%), and finishes the assignment (100%). 13 assignments that make up the standing space were evaluated, and the highest score was 39.

Paediatric balance scale:

The Paediatric Balance Scale, which was developed by modifying the Berg Balance Scale, is used to gauge balance in children between the ages of 5 and 15 who have motor impairment. Instructions for the exam, the order of the tests, and the amount of time needed to maintain static posture have all changed. There is a maximum score of 56 points¹³. This scale measures how well 14 typical daily tasks—including the capacity to sustain increasingly challenging sitting and standing positions—are performed. In order to evaluate standing balance, progressively smaller BOS were offered. The goal of this test was to examine children with neurological conditions.

Procedure

10 cerebral palsy patients between the ages of 4 and 10 were chosen, divided into two, these participants underwent a Gross Motor Function Measure evaluation of developmental group and experimental group. Using an assessment of Gross Motor Function Measure, all of these participants were evaluated. For two months, the patient had two hours of developmental therapy five days a week, this included.

GROUP A

- General warm-up exercises for the body,
- Flexibility exercises,
- Resilience exercises and muscle stretches,
- Resistance training with dumbbells and an elastic band,
- Exercises require coordination and balance.

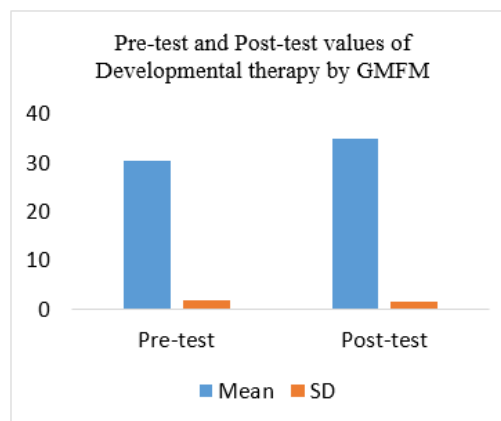
GROUP B

- The spider cage therapy that the subjects in this group underwent for two months, lasting two hours per day, five days per week, Spider Cage therapy is used to develop strength by concentrating on one muscle group without using another (weights and pulleys) after a general warm-up and easy stretches.
- A spider cage is used as therapy to help with movements including sit-to-stands, quadrupeds, squats, and jumping, as well as balance and coordination.

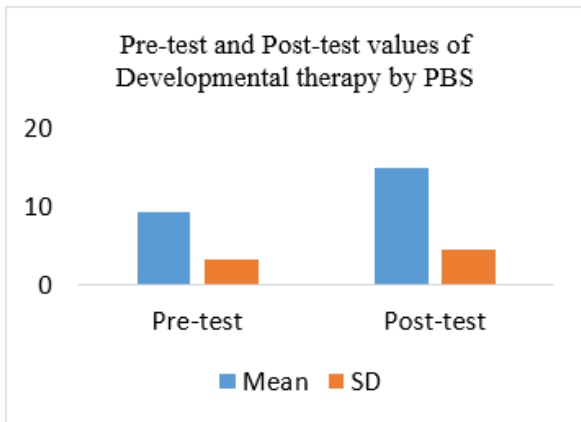
Data Analysis

Inferential and descriptive statistics were applied to tabulate and evaluate the collected data. All parameters have been transformed into their mean and standard deviation (SD). A paired t-test was employed to evaluate whether any significant improvement in between pre- and post-test measurements. Statistics were considered significant at P values less than 0.0001.

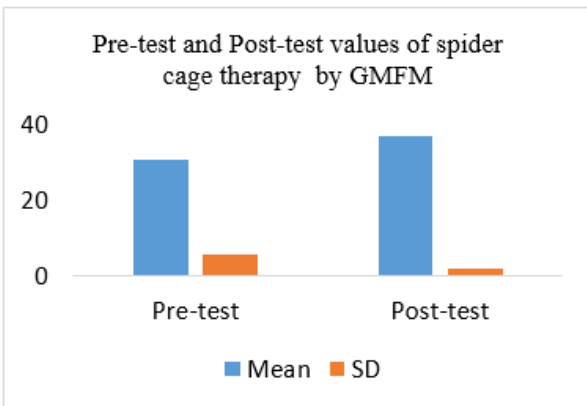
All 10 subjects completed the study successfully; test and post values of GMFM and PBS were presented in following graphs. Statistical analysis shows significant improvement from pre-intervention to post.



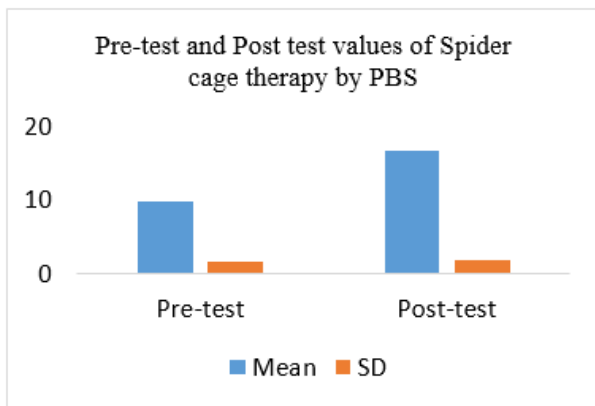
Graph 1: The pre and post-test values of developmental therapy by GMFM



Graph 2: The pre and post-test values of developmental therapy by PBS



Graph 3: The values of pre and post-test values of spider cage therapy by GMFM



Graph 4: The values of pre and post-test values of spider cage therapy by PBS

Result

For the GMFM scores, the developmental therapy group showed an average value of 30.2 in the pre-

test and in the post-test. In contrast, the spider cage therapy group had an average value of 30.55±5.63 in the pre-test and 36.95 in the post-test. The p-value of less than 0.0001 for both groups indicates that there was a statistically significant improvement in motor function in both groups after the therapy, with the spider cage therapy group showing a slightly higher improvement compared to the developmental therapy group.

Regarding the PBS scores, the developmental therapy group had an average value of 9.2 in the pre-test and 14.95 in the post-test, while the spider cage therapy group had an average value of 9.75 in the pre-test and 16.7 in the post-test. Similar to the GMFM scores, the p-value of less than 0.0001 for both groups indicate a statistically significant improvement in balance control for both groups after the therapy, with the spider cage therapy group again showing a slightly higher improvement to the developmental therapy group.

Discussion

This study investigated the effects of spider cage therapy on balance in kids with spastic diplegic CP. Children with CP often step incorrectly as a result of balance-related motor impairments. This project aimed to increase balance. The developmental group prior to and following treatment showed a noticeable difference, whereas the study group showed a considerable improvement, according to stance domain results in GMFM. This may be due to the fact that they regularly engaged in physical activities, which are consistent with Mark and Gromley’s findings,⁽¹⁰⁾who found that physical therapy significantly improves selective motor control, leading to improved function.

According to Levinson, spider cage therapy is a cutting-edge and efficient treatment option for children with cerebral palsy that significantly improves balance, body coordination, and performance. It also makes the most of the child’s strengths and abilities and can be used in conjunction with the majority of rehabilitation procedures to encourage independence and security while preserving postural stability. Furthermore, it agrees with studies by Haart et al. (9)

A therapy method called "spider therapy" developed by Gamit and Sutaria ⁽¹²⁾ uses a hanging web-like apparatus to aid and assess the motor skills of people with neurological illnesses. It requires a variety of motions while hung in the device, including reaching, gripping, and weight shifting. This study looked at how balance and motor skills in people with cerebral palsy were affected by spider therapy. The Functional Independence Measure (FIM) and the Gross Motor Function Measure (GMFM), which are standardised assessment methodologies that provide precise assessments of motor skills and functional abilities, were used to study motor functions. To assess equilibrium, we used tests created expressly for that purpose.

The main advantage of suit therapy, according to Alagesan and Shetty, ⁽¹³⁾ is the considerable increase in sensory proprioceptive feedback, which promotes the growth of cortical regions where embryonic development in children with development was slowed. Suit therapy has benefits such as supporting weak muscles, building endurance in strong muscles to increase power, assisting in the decrease of contractures, enhancing coordination, and offering tactile stimulation. Restoring muscle tone, allowing the body to return to normal, reestablishing gait patterns, and providing tactile feedback are some of the objectives of external stabilization. The study discovered important links between spasticity and other aspects of motor function. Higher spasticity scores, which were correlated with lower GMFM-66 scores, are indicative of poorer gross motor function. As a result of their heightened muscle rigidity and tone, persons with spastic diplegia cerebral palsy may experience functional restrictions. Spastic diplegia is a type of cerebral palsy characterized by rigidity and elevated muscular tone, primarily in the lower extremities. This condition was the focus of the investigation. Spasticity can have major negative consequences on mobility and motor function in CP patients, thus it's crucial to understand how it interacts with other factors when developing a therapy strategy.

Conclusion

The findings of the study conclude that spider cage therapy has an impressive effect in improving

balance in children with cerebral palsy. Treating children who had spastic diplegic cerebral palsy with spider cage therapy along with developmental therapy over a period of 4 consecutive weeks improves their balance control as indicated by improvements in the gross motor functional measure scale (GMFM) and Paediatric balance scale (PBS). As such, there is strong evidence to suggest that the application of spider therapy and developmental therapy in combination with standard care represents a simple, yet highly effective.

ISRB approval: This research work has been approved by ISRB committee

Conflict of Interest: No conflict of interest.

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