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Health Science

# EFFECT OF POSTURAL BALANCE TRAINING ON GAIT PARAMETERS IN CHILDREN WITH CEREBRAL PALSY

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**ABSTRACT**

**BACKGROUND AND AIM-** It is well known that the children with cerebral palsy (CP) have varying levels of deficits in balance and postural control, which is a major component of the gait disorder. Postural control, specifically postural stability, is a fundamental prerequisite for motor development in children. Therefore the aim of this study was to see the effect of postural balance training on gait parameters in children with cerebral palsy.

**METHOD:** Thirty children with spastic diplegia (8-10 yrs) were included in this study. The children were randomly assigned into two groups: control group A and study group B. The children in both groups received traditional Occupational therapy program, 2 hrs per day for group A and 1.5 hrs followed by 30 mins of dynamic postural training program using the phyaction balance System for group B. The treatment frequency was three sessions per week for 8 consecutive weeks. The participating children received pretreatment and post treatment assessments using the phyaction balance System to evaluate the stability indices (anteroposterior, mediolateral, and overall) .All the subjects were evaluated pre therapeutically and post therapeutically using the pediatric balance scale and the gait parameters were also taken(cadence, stride length ,step length)..

**RESULTS:** The children in both groups showed significant improvements in the mean values of all measured variables after treatment indexed by a significant reduction in stability indices and improvement in gait parameters. The results also showed significant differences in all measured parameters in favor of group B, when compared with those in group A ($P < 0.05$).

**CONCLUSIONS:** Balance training on phyaction balance the System could be a useful tool in conjunction with traditional Occupational therapy program for improving balance control and gait functions in children with spastic diplegic cerebral palsy.

**KEYWORDS :**

**Introduction:**

The posture control needed to maintain an upright stance is a very important and basic requirement in daily human life[1] .(wallmanm,2009). Posture control requires visual and vestibular inputs ,as well as both proprioceptive and tactile somatosensory inputs ,to control posture-regulating muscles in the whole body ,especially in the lower limbs and trunk [2]. (Horak and Macperson,1996).Thus the CNS needs to control multiple muscles multisensory inputs.

Children with diplegic cerebral palsy (C.P) may have impaired postural balance that contributes to their gait abnormalities. Deficits in postural control mechanisms have been suggested to be a major component of gait disorders in CP[3]. (Berger et al,1984)

Abd EL-kafy EM etal , 2014,in their study to evaluate the effect of dynamic bilateral postural stability on balance control and gait parameters in children with cerebral palsy used the Biodex stability system, and concluded that balance training improved gait functions in children with cerebral palsy[4].

El-Samy SM, et al , 2014,in a study on the Effect of balance training on postural control and risk of fall in children with diplegic cerebral palsy, used the Biodex system concluded that Biodex system is a useful tool that can be used in improving postural balance control in children with diplegic cerebral palsy[5].

Abdel-A Ziem AA ,2017 ,et al. Clin Rehabilitation,(2017),in their study on effectiveness of backward walking training on walking ability in children with hemiparetic cerebral palsy, suggested that backward walking is more effective than forward walking training on spatiotemporal gait parameters, and gross motor function measures in children with hemiparetic cerebral palsy[6].

Balance training is a fundamental approach to improve performance and recover stability in children with CP[7]. (Shumway Cook A 2003) .

Phyaction balance system has been used for assessment and treatment of balance disorders in unilateral lower limb amputee and hemiplegia (Sethy et al,2009 Kujur et al ,2017).

However, none of the previous studies have investigated the effect of using the phyaction balance system in cerebral palsy patients. Thus the study was conducted to see the effect of postural balance training on gait parameters in children with diplegic CP using phyaction balance system.

**Material and Methods:**

Thirty children with spastic diplegia (21 boys and 09 girls) were included in the study from the Department of Occupational Therapy ,NILD, Kolkata. The subjects were selected and randomly a divided into two groups ,group A and group B,15 in each group. The inclusion criteria : Children aged from 5 to 10 years who are able to independently maintain standing position for balance training using the Phyaction balance board, who have a grade 1 to 1+ spasticity according to modified Asworth scale ,who have minimum height of one metre, and who are able to follow commands were included in the study. Exclusion criteria: included having visual or auditory problems, perceptual or cognitive disorders, significant tightness or fixed deformity related to any joints of the lower limbs.

**Evaluative and therapeutic tools:**

We used the paediatric Berg balance scale and the gross motor functional measure scale (GMFS), in addition to the phyaction balance board ,version 2.0,2005,used for the balance training.

**Procedure:**

Written informed consent was obtained from each participants guardian .The children's demographic data were collected. Pre and post therapeutically subjects were administered the pediatric balance scale, the demographic data, and the gait parameters were also recorded. The duration of therapy was 3 times per week for 8 weeks.All the subjects underwent the conventional Occupational Therapy .the subjects in the experimental group underwent the phyaction balance training.

**Phyaction balance training:**

On the first day of training level of balance exercise performance of the patients' was evaluated. Patients stood erect on the moving Board with their hands along side their bodies. Patients were instructed to stand with both feet on the floor as motionless as possible to maintain balance while the board sways over a diameter of 40 centimeter both in medio-lateral and antero-posterior direction .For safety purpose one therapist stood near by the patient. The movement of the board was set in the exercise program for individual patients. Feet position selected for the patient was bilateral, position of the patient was standing, Board heading was straight for medio-lateral balance control exercise and transversal for antero-posterior balance exercise. Graphic presentation

of the exercise was set complete which will show the board and the graphic presentations on the screen .Each patient got both visual and auditory feedback from the screen. The amplitude and frequency of movement was set to be 3 degrees and 3 cycles/ min respectively. Patient was asked to stand on the Proprioceptive board and the program was set starting from level one exercise. If the patient could do level-1 without any error then the next level of exercise was done. Initially most of the patients could do balance level two, so the exercise was set starting from balance level-3 and progressed to the next levels as the patient's ability to control balance progressed without covering extra area. With the improvement of the patient's ability the level of difficulty was increased. All the patients in the Experimental group received 15 minutes of medio-lateral balance control exercise and 15 minutes of antero-posterior balance control exercise.

Each 15 minutes were divided into 5 sets of exercise of 3minutes each set. After each three minutes of exercise patients received 1 minute rest. Each patient received antero-postero balance control exercise after completing 15 minutes of medio-lateral exercise in the same manner. Exercise performance was noted on initial evaluation and after 8 weeks of training.

**Phyaction Balance board**

**Statistical Analysis:**

All statistical Analysis were performed using spss 23.A paired sample t test was used to compare findings before and after training in each group .

A p value of < 0.05 was considered statistically significant. The independent t test was used to see the between group differences for all the outcome measures.

A total of 30 patients diagnosed as cerebral palsy including 20 males and 10 females with age range of 5.0years to 10 years were included in the experimental (n=15) and control (n=15) groups .Descriptive statistics shows baseline findings for both groups .There were no significant differences between groups.

The between group analysis showed a significant results for PBS ,P.000, stride length p=.003,step length p=.000,cadence p=.000.

**Table 1:Control Group, Descriptive Statistics.**

| Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| weight | 15 | 12.00 | 20.00 | 15.8000 | 2.67795 |
| height | 15 | 3.11 | 5.40 | 3.8747 | .69583 |
| PBS | 15 | 52.00 | 55.00 | 54.2667 | .96115 |
| CADANCE | 15 | 70.00 | 125.00 | 86.4000 | 16.06594 |
| STEPL | 15 | 15.25 | 30.27 | 20.1567 | 3.74885 |
| STRIDEL | 15 | 19.31 | 24.43 | 21.7260 | 1.56221 |
| Valid N (listwise) | 15 | | | | |

**Table 2:Experiemental Group-Descriptive Statistics.**

| Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| weight | 15 | 10.00 | 20.00 | 15.0667 | 2.84019 |
| height | 15 | 3.11 | 5.40 | 3.7147 | .55633 |
| PBS | 15 | 47.00 | 53.00 | 50.6000 | 1.76473 |
| CADANCE | 15 | 52.00 | 114.00 | 65.2000 | 20.01856 |
| STEPL | 15 | 10.00 | 18.00 | 14.0000 | 2.59119 |
| STRIDEL | 15 | 14.00 | 18.00 | 16.2473 | 1.55854 |
| Valid N (listwise) | 15 | | | | |

**Table -3 Between group ,t test**

| Independent Samples T Test Means | | | | |
|---|---|---|---|---|
| | | t-test for Equality of Means | | |
| | | t | df | Sig. (2-tailed) |
| PBS | Equal variances assumed | -7.067 | 28 | .000 |
| | Equal variances not assumed | -7.067 | 21.634 | .000 |
| CADANCE | Equal variances assumed | -3.199 | 28 | .003 |
| | Equal variances not assumed | -3.199 | 26.747 | .004 |
| STEPL | Equal variances assumed | -5.232 | 28 | .000 |
| | Equal variances not assumed | -5.232 | 24.891 | .000 |
| STRIDEL | Equal variances assumed | -9.616 | 28 | .000 |
| | Equal variances not assumed | | | -9.616 |

The t test shows significant improvement in balance.

**Discussion:**

The aim of this study was to see the effect of postural control training on gait in diplegic CP patients with phyaction balance board. The results show that there is a significant improvement in the balance gait parameters following the postural control balance training through phyaction balance board p value for PBS=.000 .

The results are supported by another , by Abd El-kafy EM,et al evaluated the effect of dynamic bilateral postural stability on balance control and gait parameters in children with CP .They concluded that dynamic balance training on the Biodex balance system improved the balance control and gait functions in children with spastic diplegic cerebral palsy[4] .

Postural control specifically postural stability ,is a fundamental prerequisite for motor development in children .It is the complex ability of an individual to maintain the centre of gravity of the body over the support base when we are standing still (static balance ),in motion( dynamic ,functional balance),preparing to perform a movement or preparing to end a movement[10].

Postural control depends on the delicate integration of vision, vestibular and proprioceptive sensations, commands from the central nervous system and neuromuscular responses Balance training is a fundamental approach to improve performance and recover stability in children with CP Balance training is a fundamental approach to improve performance and recover stability in children with CP[11].

Every individual must constantly maintain postural control balance while propelling himself forward to move in space[12] .

Recent studies have focused on the learning and rehabilitation applications of motion control, including posture control. A recent study (Nardone et al., 2010) reported rehabilitation in patients with disorders of peripheral neuropathy, as well as vestibular disorders, using a moving platform. The improvement of balance control provided by this intervention is similar to that seen with the application of Frankel exercises[13].

The phyaction balance board has provides the proprioceptive input and also provide the visual and auditory feedback to the subjects. This may be attributed to the improvement in the balance and thereby its influence on the gait parameters.

The phyaction balance system also provides a postural sway by providing external perturbations through the moving platform.

**CONCLUSION :**

The present study showed the effect of perturbation on balance control of diplegic cerebral palsy children and thus gives evidence that during early postural training, balance training should be incorporated in the rehabilitation program of diplegic cerebral palsy children for their development of balance and improvement in gait. Future studies can be conducted to see the effectiveness of Medio-lateral balance control and Anteroposterior balance control in diplegic cerebral palsy children. Future studies may be conducted on larger population.

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