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Effect of Suspension Therapy on Balance in Spastic Diplegic Cerebral Palsied Children

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Abstract: Performance of daily living activities for children with cerebral palsy is often a major challenge required main training for postural control. The purpose of this study was to investigate the effect of suspension therapy on balance in spastic diplegic cerebral palsied children. Twelve spastic diplegic cerebral palsied children participated in this study. The children were assigned randomly into two equal groups; control group and study group. All children were assessed for functional performance by Gross Motor Function Measure and balance by Pediatric balance scale. Both groups received specially designed physical therapy program to improve balance while the study group received the same specially designed physical therapy program but inside the suspension therapy. The treatment continued for eight successive weeks, three times/ week. Pre-treatment results revealed non significant difference in Gross Motor Function Measure and Pediatric balance scale mean values between the two groups. Pre and post treatment results for the control and study groups revealed significant improvement in all measuring variables of the two groups. Post treatment results of the both groups revealed significant improvement in all measuring variables in favor of the study group. Conclusion: suspension therapy was effective in improving motor functions and balance in spastic diplegic cerebral palsied children.

Key words: Cerebral Palsy · Suspension Therapy · Balance

INTRODUCTION

Cerebral palsy (CP) is the motor disorder described by an impairment of movement that results from non-progressive injury in the developing infant brain[1].The disturbances in cognition, perception and balance disorder are often accompanied with physical impairment and include spasticity and weakness, which impair the normal daily activities. Risk of CP has been increased by associated maternal disease,genetic predispositions,low birth weight, birth asphyxia and preterm birth[2].

Cerebral Palsy children have many disorders of movement, posture, poor manipulative skills and poor walking abilities caused by the damage to the motor cortex. Poor balance control is one of the factors that contribute to problems in reaching movement and gait because the stabilization maintenance is critical to all movements [3].

Spastic diplegia is the most common type of cerebral palsy, which is the whole body involvement but the upper half is less affected than the lower half. Head control and upper limbs control are usually less affected and nearly

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normal in speech [4]. The most of these groups of children are walking independently with crouch gait because of spasticity in the hip flexors and adductors, hamstring muscles and calf [5].

Spastic Diplegic children have poor balance control that is one of the main factors to their abnormal gait and reaching movement as maintaining stability is critical to all movements[3].Instability in ambulation, higher incidence of falls and extra muscle tension usually develop in the chest, shoulders and arms due to compensatory stabilization movements. Initiation of activity is difficult because child cannot move from one posture to another hampering performance of voluntary movement, increased cost efficiency of gait and early fatigue [6].

Posture control is essential for obtaining good balance. The visual, proprioceptive, vestibular and other higher-level premotor systems are integral of multiple body systems and required for balance achievement[7].

Control of balance is important for the most functional skills performance that helps children to regain from unexpected balance disorders. The functional goals of balance system include facilitation of some voluntary movement like transitions between postures, maintenance of certain posture, such as sitting or standing and restoring the equilibrium after external disturbances like a slip or to self- induced instability [8].

Disability and balance impairment have individual causes related to the various mechanisms involved. Decreased range of movement, motor coordination, muscle strength, cognition, sensory organization, multisensory integration and abnormal muscle tone lead to balance disorders at different levels [9].

Suspension therapy is an innovative and effective modality for treatment of cerebral palsy child.The equipment of rehabilitation is called "Spider".Disorders of the central nervous system (CNS) lead to various diseases of mobility and physical deficits. Suspension system (Spider cage) was utilized to help the child to overcome the gravitational effect on their static and dynamic patterns[10].

Suspension therapy can be combined with selective exercises, physical therapy methods and can be successfully combined with most of rehabilitation programs and sport equipments to improve postural stability. Balance, coordination of the body segment and the performance of the vestibular system are important for promoting independence with security, also, they allow more full use of the patient's strength and abilities [11].

The aim of the study was to investigate the effect of the suspension therapy exercise program on balance in spastic diplegic cerebral palsied children.

MATERIALS AND METHODS

Twelve spastic diplegic cerebral palsied children of both sexes and their ages were ranged from 6 to 12 years old participated in this study and they were divided into two equal groups,control (Group A) and study (Group B) groups. All children had a spasticity degree ranged from 1 to 2 grades according to modified Ashworth scale [12] and their levels of gross motor skills ranged between levels II & III according to Gross Motor Function Classification system (GMFCS).

Exclusion Criteria: Children with perceptual or visual deficits, children with seizures or epilepsy, marked hip and knee flexion contractures, serious medical complications, children with fixed deformity of both lower limbs and children with surgical interventions, e.g. tendon release.

Children in the control group received a specially designed physical therapy program and children in the study group received the same program given to the control group but inside the suspension therapy. The treatment session lasted one hour for each child and was conducted three times/week for eight successive weeks. All children were assessed before and after the treatment by Gross motor function measure and Pediatric balance scale.

Procedures: After explanation of the study objectives and procedures, an informed consent was obtained from the children's parents about agreement of study participation.

Evaluation Procedures

Gross Motor Functional Measure (GMFM): Gross motor functional measure (GMFM) is a quantitative measurement, which measures amount of a task the child can accomplish, rather than how well the task is completed. It is appropriate for children with CP at the age of five months to sixteen years. It contains eighty-eight items in five gross motor dimensions (Lying and rolling – Crawling and kneeling – sitting – standing – walking, running and jumping), they may be tested in any order. A maximum of three trials for each item and it scores as given below:

0- Does not initiate the task, 1- Initiates the task (< 10 %), 2- Partially completes the task (10-99 %), 3- Completes the task (100 %)

The scores given are based on the best performance out of three trials. Standing domain was assessed which consists of 13 tasks with maximum score 39.

Pediatric Balance Scale (PBS): Berg Balance Scale was modified into the Pediatric Balance Scale to be used as a balance measure with mild to moderate motor impairment for school-age children between 5 and 15. The modifications include: sequence of test, test instructions and the time for maintaining static posture. This test can be administered and scored within fifteen minutes. The fifty-six point is the maximum score [13].This scale evaluates performance of fourteen activities common in everyday life, indicating the ability to maintain sitting and standing positions of increasing difficulty. Evaluation of standing balance was carried out by providing progressively smaller BOS. This test was used to assess subjects with neurological disorders [14].

Treatment Procedures: Children in the control group received specially designed physical therapy program while children in the study group received the same program of control group but inside the suspension therapy.The suspension therapy was used to place the child in standing position in the center of the cage. The child was hooked up in the suspension therapy by means of a belt around the waist that attached to the cage using elastic cords. The belt was fixed around his trunk by Velcro straps. The elastic cords were applied in a spider shape. This suspension therapy provides horizontal and vertical dynamic features of functional suspension as a support, assistance, or even resistance during training. The suspension therapy also provides just the right amount of support needed for securing and balancing patient while practicing or performing needed movements [10].

The specially designed physical therapy program that was given to the control group and also to the study group but inside the suspension therapy included neurodevelopmental technique,facilitation of standing posture, facilitation of postural mechanism, muscle stretching, strengthening exercises, proprioceptive training and balance and gait training for eight successive weeks.

Statistical Analysis: The data were collected before and after eight weeks of training for both groups.Data statistical analysis was done using the statistical package for social sciences (SPSS) version 20. Data was presented as mean and standard deviation. Unpaired t- test was used to analyze the data between study and control groups. The p-value was <0.05

RESULTS

General Characteristics: As shown in table (1), the control group consisted of six patients and their mean age was 8.83 ± 2.04. The study group consists of six patients and their mean age was 8.5 ± 1.87.The results revealed non significant difference in age of the patients between both groups (p=0.77).

Gross Motor Function Measure (GMFM): The results showed a significant difference in GMFM mean values before and after treatment in control group (p = 0.001)and the study group (p = 0.0001). The results showed a non significant difference between control and study groups before treatment (p = 0.68) while the results showed a significant difference after treatment (p= 0.03) as shown in table (2).

Pediatric Balance Scale (PBS): The results showed a significant difference in PBS mean values before and after treatment in the control group (p = 0.034) and the study group (p = 0.0001). The results showed a non significant difference between control and study groups before treatment (p = 0.069)while the results showed a significant difference after treatment between control and study groups (p = 0.01) as shown in table (3).

Table 1: The mean values of the age of the patients in both two groups.

Item	(Control Group) mean ±SD	(Study Group) Mean ±SD	T	P
Age (years)	8.83 ± 2.04	8.5 ±1.87	.29	0.77

* Significant at = 0.05, SD: standard deviation.

Table 2: Comparison between control and study groups mean values of GMFM before and after treatment.

GMFM	(Control Group) mean ±SD	(Study Group) Mean ±SD	*t*	P
Pre	20.5± 2.88	21.33 ±3.88	-0.42	0.68
Post	22.66 ± 3.14	28±4.14	-2.51	0.03*
T	-7.05	-13.4		
P	0.001 *	0.0001 *		

* Significant at = 0.05, SD: standard deviation.

Table 3: Comparison between control and study groups mean values of PBS before and after treatment.

PBS	(Control Group) Mean ±SD	(Study Group) Mean ±SD	T	P
Pre	30.66± 3.26	31.33± 2.42	-0.4	0.069
Post	31.83± 4.21	38.33± 2.66	-3.19	0.01*
T	-2.9	-15.65		
P	0.034*	0.0001*		

* Significant at = 0.05, SD: standard deviation.

DISCUSSION

This study was conducted to investigate the effect of suspension therapy on balance in spastic diplegic CP children.

Gait abnormalities in children with CP are because of motor impairments that are associated with impaired balance control. Therefore, improve balance was the focus of this study.

The results of standing domain before and after treatment in GMFM showed significant difference in control group and high significant improvement in study group. This could be attributed to the regular physical activities conducted for them which come in agreement with Mark and Gromley[15] who stated that physical therapy improves selective motor control significantly enough to improve function.

Levinson[11]stated that suspension therapy is an innovative and effective modality for rehabilitation of CP children significantly improves balance, coordination of the body and the performance and it allows full use of the children strength and abilities that can be successfully combined with most of rehabilitation equipment to give postural stability while promoting independence with security.

Also that comes in consistency with Haart et al.[16] who studied the association between quiet standing and functional activity as walking and it has been shown that postural control during quiet standing was related to the weight-shifting ability.

The current study showed higher improvement in PBS in CP children after suspension therapy in the study group than the control group and this could be attributed to improvement of trunk control by transfer of body weight to right and left and dynamic balance through using suspension as it helps in stabilization of the patient allowing minimal displacement of center of pressure (COP) maintaining the COP close to the midline so decreases the postural sway which reflected a good balance which come in agreement with Keen[17] who reported that training with the use of suspension therapy helped the patient to overcome the effect of gravity on their static and dynamic movements and helped in keeping the body from collapsing.

Also, the improvement of balance may be attributed to the effect of suspension therapy on improving lower limb proprioceptive sense which come in agreement with Olama and Thabit[18] who reported that loading and unloading by using suspension therapy through alteration of the proprioceptive sense lead to improvement of weight bearing activities.

The results of this study come in agreement with Stillman[19] who reported that proprioceptive awareness of postures and movements is most required during the learning of new skills and also with slower movements the proprioceptive system can monitor and adjust the movement as it occurs. Moreover Senior[20]stated that improving balance and coordination of the body as a result of exercises inside the suspension unit give postural stability and promote independence with security.

CONCLUSION

In conclusion, performing balance exercises by using suspension therapy was more effective in improving the balance in children with spastic diplegic cerebral palsy.

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