EFFECT OF UPSEE MOBILITY DEVICE ON HIP JOINT ANGLE IN SPASTIC DIPLEGIC CHILDERN

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ABSTRACT

The purpose of this study was to investigate the effect of Upsee mobility device on hip joint angles in diplegic cerebral palsied children. **Subjects:** Thirty spastic diplegic cerebral palsied children of both sexes participated in this study, they were divided randomly into two groups of equal numbers (control and study). **Materials:** The children in the control group received the traditional physical therapy program for diplegic cerebral palsy for one hour including gait training. Children in study group received the same physical therapy program for thirty min in addition to gait training using the Upsee mobility device for thirty min. Children in both groups received sessions three times/week for three successive months. **Methods:** Both groups were evaluated before and after the treatment programs by Tracker Video Analysis and Modeling Tool. **Results:** The results of the current study revealed that there was statistically significant improvements in hip joint angles pre and post treatment at different measuring periods during gait cycle subphases in both groups. Improvements in post treatment results were in favor of study group compared with control group. **Conclusion:** Upsee is a clinically feasible approach for improving gait in children with spastic diplegia through providing increased free opportunities for walking via supporting biomechanical alignments.

Key Words: Diplegic Cerebral Palsy, Upsee mobility device, Gait.

Introduction

Cerebral Palsy (CP) would be better named "the cerebral palsies" given that within the CP clinical spectrum, there are many causal pathways and many types and degrees of disability. These various pathways and etiologies have resulted in a nonspecific, non-progressive disorder of posture and movement control. Thus, CP should be considered as a descriptive term for affected individuals, with each case receiving adequate consideration of an underlying etiology[(1)].

Classification system of cerebral palsy has a broad clinical symptoms with categories for physiology (the nature of the motor abnormality), topography, etiology, neuroanatomical features, supplemental (associated) conditions, functional capacity (severity), and therapeutic requirements. Experts continue to address these broad categories when classifying CP [(2)]. Diplegia means weakness of all four limbs, but the legs are weaker than the arms. The motor impairment in the arms may be limited to increased responses of tendon reflexes; the classification of such children is *paraplegia*. Periventricular leukomalacia is the commonest cause of spastic diplegia in premature children. Cystic lesions in the white matter are often unilateral or at least asymmetrical, causing hemiplegia superimposed on spastic diplegia[(3)].The gait pattern of a child with diplegia can vary greatly depending on the degree of severity of involvement. Generally, children with spastic diplegic-pattern CP ambulate at about half the speed of children without CP. Unlike hemiplegia, there are few children with diplegic CP with only ankle involvement. The great majority of children with diplegic CP has some hip, knee, and ankle involvements. Despite this increased level of involvement, most children with diplegic CP can walk independently, although more severely involved children with diplegic CP require molded ankle–foot orthoses (MAFOs) and an assistive device.[(4)].

There are many mobility devices that help people with CP to be ambulator, either to walk or to move around in another way. Any equipment should be prescribed by professional staff according to the patient's needs. The device has to be appropriate for the patient's functional abilities. In the case of a child, it should be appropriate for the stage of a child's development and should not hinder child's developmental progress. Equipment should be made according to the patient's measurements and it must be adjusted as growth occurs[(5)].

The Upsee may enable the child to achieve an upright position and mobile weight bearing through their lower limbs. The degree of weight bearing through the lower limbs is increased or decreased as the therapist and parent adjusts the supporting straps in response to the child's own ability to take weight through their legs. So that the child uses their optimum lower limb strength to maintain an upright posture[(6)].

The purpose of this study is to determine the effect of Upsee mobility

device on hip joint angles in children with spastic diplegic cerebral palsy.

Subject, materials and methods

Subjects:

Thirty spastic diplegic cerebral palsied children of both sexes participated in this study. They were selected from the Outpatient Clinic of the Faculty of Physical Therapy of Cairo University and Faculty of Physical Therapy 6th October University. Subjects were selected regardless of the cause of cerebral palsy.

They were chosen according to the following criteria:

Inclusive criteria: Their ages were ranged from 3 to 6 years. All patients have mild to moderate spasticity according to modified Ashworth scale (grade 1, 1+). They were able to understand and follow simple orders. They had no visual or auditory problems. They had no history of surgical interference in the lower limb. They were able to walk with limitation or holding on according to Gross Motor Function Measure GMFM (level III &IV). They are not under treatment of special medications that affect mental functions. They had no convulsions. They had no fixed deformities in lower limbs. They had abnormal gait kinematics, which can be observed from assessment of gait kinematics by using 2D video analysis software.

Exclusive criteria:

1- Children with a history of epilepsy.
2- Children receiving any anti spastic drugs.
3- Children with chest infections or unstable cardiac status.
4- Children with infectious skin conditions.

Design of the study

The selected subjects were divided into two groups of equal numbers (control and study). **Control group;** The children in this group received traditional physical therapy program of the diplegic CP in addition to gait training program for one hour, 3 times/ week for 3 successive months. **Study group ;** The children in this group received the same traditional physical therapy program for thirty minutes in addition to 30 minutes gait training by using the Upsee mobility device.

Instrumentations

A) For evaluation: 2D, video based gait assessment system: The Tracker Video Analysis and Modeling Tool allows to model and analyze the motion of objects in videos. By overlaying simple dynamical models directly on two videos for measuring the gait parameters for both lower limbs during walking.

B) For treatment

a-Parallel bar, wedges, rolls, balance board, balance beam, stepper, gravity bar, balls, standing bar, mats.

b- Upsee mobility device:

The system consists of a waistcoat for the child, with a pelvic belt, groin supports and adjustable straps to connect the child from his/her shoulders to the adult's pelvic belt. The child and adult also share sandals, which accommodate the child and

adult's feet in each sandal. The child stands with support as required for the adult. Child and adult step simultaneously with the child's arms free to play.

METHODS

1- Traditional physical therapy program.

- Facilitation of righting and equilibrium reactions to improve postural mechanisms via variety of exercises applied on ball and balance board through tilting from different positions in forward and backward and sideways. Facilitation of protective reactions by applying fast and large amplitude of stimulus to train saving reactions from sitting on roll, also from standing position by pushing the child to enhance the child to take protective steps either forward, backward or sideways to regain balance.
- Training for active trunk extension to improve postural control and balance.
- Facilitation of standing from supine and prone position and weight bearing in addition to weight shifting exercises by facilitation of single limb support while standing.
- Flexibility exercises for hamstring, iliopsoas and calf muscles to increase range of motion for treatment of limited ROM and poor balance. Strengthening exercises for all antigravity muscles. Gait training (traditional gait training exercise) include walking in all directions (forward, backward, and sideways). Obstacles were used on the walkway inside and outside the parallel bar such as:
- Wedges with different heights.
- Rolls with different widths.
- Climbing stairs up and down.
- Steeper.
- Walking on different floor surfaces (spongy and hard surfaces) on mat, floor and carpets.

2- Exercises using the Upsee mobility device.

A-Standing exercise:

1. Throwing and catching ball in multi directions and for different distances.
2. Weight bearing exercises through double and single limb standing.
3. Step standing.

B-Gait training exercise:

1. Closed (without obstacles) and open environment (with obstacles e.g. wedges with different height , and rolls with different widths) ,climbing stairs up and down and walking in steeper.
2. Reciprocal walking movements by using sticks.
3. Kicking ball for different distances.

Results

Data obtained from both groups pre and post treatment regarding hip joint angles during gait cycle are statistically analyzed and compared.

Table (1): Comparison between right hip joint angles in study and control groups during gait cycle at different measuring periods

Independent sample T test		Initial contact	Loading response	Mid stance	Terminal stance	Pre-swing	Initial swing	Mid swing	Termina l swing
Pre	Mean difference	1.46	0.14	-1.89	2.76	-2.19	2.99	-5.22	-2.21
	t-value	1.058	.095	-.748	1.026	-.850	2.438	-2.125	-1.466
	p-value	.081	.925	.461	.084	.402	.090	.079	.154
	S	NS	NS	NS	NS	NS	NS	NS	NS
Post	Mean difference	3.84	3.46	4.74	11.48	5.54	8.82	4.47	23.92
	t-value	3.899	2.393	5.034	17.698	5.934	7.446	2.522	1.167
	p-value	.001*	.024*	.0001*	.0001*	.0001*	.0001*	.018*	.253
	S	S	S	S	S	S	S	S	NS

t: the size of difference, P: probability, *S: significant at P level <0.05, NS: non-significant.

As presented in table (1), independent sample t-test revealed that the mean values of the pre-treatment between both groups showed there was no significant differencesat initial contact, loading response, mid stance, terminal stance, pre-swing, initial swing, mid swing, and terminal swing.

Also, independent sample t-test revealed that the mean values of the post-treatment between control group and study group showed there was a significant differences of right hip joint angles at initial contact, loading response, mid stance, terminal stance, pre-swing, initial swing, mid swing. While, there was no significant difference at terminal swing.

Table (2): Comparison between left hip joint angles in study and control groups during gait cycle at different measuring periods

Independent sample T test		Initial contact	Loading response	Mid stance	Terminal stance	Pre-swing	Initial swing	Mid swing	Terminal swing
Pre	Mean difference	2.387	-1.5	3.386	3.72	1.167	.973	-3.227	-2.613
	t-value	1.506	-1.365	1.636	1.691	.618	.854	-1.806	-1.528
	p-value	.143	.183	.113	.082	.542	.400	.082	.138
	S	NS	NS	NS	NS	NS	NS	NS	NS
Post	Mean difference	3.46	3.44	6.72	9.953	5.34	7.787	8.52	4.46
	t-value	3.959	3.896	5.348	7.421	6.393	6.375	4.479	3.164

	p-value	**.001***	**.001***	**.0001***	**.0001***	**.0001***	**.0001***	**.0001***	**.004***
	S	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

t: the size of difference, P: probability, *S: significant at P level <0.05, NS: non-significant.

As presented in table (2) independent sample t-test revealed that the mean values of the pre-treatment between both groups showed there was no significant differencesat initial contact, loading response, mid stance, terminal stance, pre-swing, initial swing, mid swing, and terminal swing.

Also, independent sample t-test revealed that the mean values of the post-treatment between control group and study group showed there was a significant differencesof the left hip joint angles at initial contact, loading response, mid stance, terminal stance, pre-swing, initial swing, mid swing and terminal swing

Discussion

The results of current study revealed that there was statistically significant improvement of hip joint angles during gait cycle at different measuring periods in both groups post treatment in favor of study group whom treated with Upsee mobility device combined with selected physical therapy program when comparing pre and post treatment mean values.

Children with CP have decreased stepping activity compared with their peers [(7)]. An association between daily step count and the gait deviation index has been reported [(8)]. It is conceivable that the increase in daily steps through use of the Upsee contributed to the improvements in gait quality. The child's increased independence and willingness to walk during the intervention period could have magnified this effect by increasing daily stepping [(9).]

Andrea Fergus,2017had shown that during walking with the Upsee, the child's foot was aligned with the caregiver's foot and attached by the footplate. Because the footplate was aligned to face forward, it did not allow the child to internally rotate or invert at the subtalar joint bilaterally. The caregiver directed lower extremity placement as well as the temporospatial stepping patterns of gait with the Upsee; it is believed that this contributed to the decrease in genu recurvatum and scissoring, and improve hip extension, in addition to more symmetrical step length and decrease in delay of swing[(9)].

Herskind et al, .2016suggested that training by using Upsee have benefitted the development of a gait pattern through improving strength of lower limb muscles and active participation[(10)].

Smania et al, .2011strongly suggest that repetitive locomotor training on a bodyweight support (UPsee mobility device) improve gait speed and endurance in children with cerebral palsy[(11)].

Conclusion

From the previous discussion of the results of this study, it can be suggested that using of Upsee mobility device can be effective in improving hip joint angle in children with spastic diplegic cerebral palsy.

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