Effect of dynamic standing frame on gross motor function in non ambulant spasticdiplegia

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Background: Anticipation (feed-forward) is crucial in movement and postural control, whichis learned through trialand error. **The purpose of this study**: was to investigate the effect of dynamic standing frame on gross motor function in spastic diplegic cerebral palsy children. **Methods**: Thirty spastic diplegic children ranging in the age from two to four years participated in this study. They were divided randomly into two groups of equal numbers (control and study). The control group was treated by especially designed exercise program, while the study group received the same treatment programgiven to the control group in addition to training on dynamic standing frame. Treatment was conducted for three successive months, at three days/week. Basis evaluation was carried out for each child individually before and after application of the treatment program.Gross Motor Function Measure was used to measure gross motor functional changes in kneeling and standing parameters.**The results**: No significant difference was recorded between the two groups before treatment, while significant difference was recorded between them in favor of the study group. **Conclusion**: According to the results of the study, it can be concluded that dynamic standing frame is a beneficial therapeutic toolthat can be used to improve gross motor function in spastic diplegic cerebral palsy children.
KEYWORDS:gross motor, dynamic standing frame, spastic diplegia

I-Introduction:

Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain.(1)In CP, damage to the immature brain is non progressive, but the

clinical expression of the disorder changes over time with the growth and development of the child[2]. In spastic diplegia, spasticity is much more pronounced at the legs than at the arms, with good prognosis for intelligence and seizures [3].Childrenwith the periventricular lesion PVL typically have spastic diparesis. A recent study found that PVL was present in 71% of thechildren with diparesis, 34% of those with hemiparesis,and 35% of those with quadriparesis[4].Adequate motor performance and postural control is needed for young children to independently perform and participate in play, activities of daily living and social interactions. Infants diagnosed as cerebral palsy demonstrate difficulties with postural control and locomotion and can miss opportunities to explore their environment[5].Gross motor function is the ability to use large muscle groups to control mass movement of the body such as walking or jumping. Motor learning is the ability to use experience in movement to obtain and maintain skilled purposeful action [6].Postural stability, or balance, is the ability to maintain and/or regain the center of mass within the base of support where gravity is the key vector[7].Functional balance, which is an element of postural control, allows a child to perform everyday tasks, activities of daily living (ADL), social activities, and recreational activities at home, in school, and in the community[8].The ability to maintain the body segments aligned and the projection of the center of mass (COM) within the limits of support are prerequisites for maintaining body balance during the performance of functional tasks. Therefore, postural control deficits are potentially limiting factors in the population with CP. Disorders of movement and posture in children with CP significantly limit participation in activities of daily living[9]. Gravitational or positional insecurity plays an important role in stable emotional development, balance and positional mechanism as well as spatial orientation. Children, who are oversensitive to motion, are afraid of being lifted from the ground (no foot contact with ground or increasing the level of their position from earth) [10]. It is common practice for physiotherapists to use standing frames to

manage the physical problems of children with cerebral palsy (CP). Gaining an insight on children's perspectives on using standing frames and the impact on their lives could provide knowledge to support physiotherapists in ensuring their practice is centered on the best interests of children [(11)]. Therapists who used standers in their supported standing programs reported benefits on weight-bearing, pressure relief, ROM, muscle strength, psychological wellbeing, and other positive effects. The strongest evidence after a standing program was found on hamstring ROM improvements[(12)].Postural management programs,such as supported standing, requires commitment from both the child and their career[(13)].Standing frame can be modified to achieve further goals such as balance training to enhance postural control, a balance board is fixed to the standing frame for balance training from standing position for children who can't stand independently. They experience balancing themselves from a position they cannot assume normally. That may enhance their potential balance capacity that will reflect on their gross motor function.In the initial point of treatment, children were supported completely. After, the child's adaptation to the stimuli, support was gradually decreased and finally omitted. Finally, stimulation was given in a standing position, center of gravity height was then at its highest level and supporting surface would be the least. The support decreased gradually until the child was able to organize his independent standing, all types of stimulation were also given in this position [(14)]. The GMFM is a functional outcome tool that wasdeveloped specifically for use in cerebral palsy[(15)].

II-Method:

Subjects: Thirty children with spastic diplegia of both sexes participated in this study; they were divided into two groups by computerized randomization manner by serial numbers from out-patient clinic, Faculty of physical therapy, Cairo University. Parents sign up consent form to participate in the study.They

were diagnosed with mild spasticity (grade 1 to +1) according to Modified Ashworth Scale. Their age ranged from 2 to 4 years chronologically. (Developmental age was around nine months). They were non-ambulant. Control group (Group 1): Children in this group received a specially designed physical therapy program.Study group (Group 2): Children in this group received the same specially designed physical therapy program given to control group in addition tobalance training on the dynamic standing frame. This study was approved by ethical committee of faculty of physical therapy, Cairo University .For evaluation:1-Modified Ashworth Scale. 2-Gross Motor Functional Measure. GMFM-88 are grouped into five dimensions only crawling and kneeling (14 items)and standing (13 items) were used in this study.Specific scoring algorithms result in a score that canbe used as an interval measure. The items are scored on four-point ordinal scales (0quarter cannot initiate; 1quarter initiates; 2 quarter partially completes item; 3 quarter completes item independently). .For treatment:Both groups received specially designed physical therapy program which concentrate on inhibition of abnormal reflexes and abnormal movement patterns and facilitation of normal movement, which may include: **I-** MATexercises (2 hours)forfacilitation of pelvic girdle control, facilitation of standing, and facilitation of postural mechanism. Berg balance scale was also used for both groups as a method of balance training in which berg balance scale graduations were used. **II-**Dynamic standing frame exercises were usedfor the study group only .This frame consist of a 70 by 70 cm bi-directed balance board with a standing frame fixed on it; standing frame is 90 cm tall with three safety belts and additional foot belts to prevent foot movement during exercise.The motion of the balance board is controlled by 4 circular springs one on each corner at the bottom of the board. The springs are fixed in a mobile base with additional lock for motion safety and easy mobility of the tool.Therapist move the standing frame slowly in one direction (ex. Mediolateral direction) and let it go, so the springs tend to rebound the movement and repeat it more times until

steadiness. Once happened, the therapist move the standing frame in another direction (ex. Antroposterior direction) and let it go again, the springs rebound the movement again in the new direction, while the child is trying to balance him/herself to overcome disturbance in balance.Every time the springs move the standing frame holding the child, he/she balance him/herself trying to keep his/her center of mass over his/her base of support.The child face two challenges to overcome, firstly, the slow wide range of movement that the therapist apply at the beginning, and then, the fast narrower repetitive movements applied by the springs rebounding.Different directions of movement stimulate the child to use different muscle groups to recover from that disturbance applied on him/her. Thedifference between balance exercise on mat and on dynamic standing frame that the later allows the child to experience balance from standing position which he/she cannot assume, so the center of mass is higher and the challenge is bigger. That may acceleratehis/her motor capabilities faster than mat exercise and give him/her a supportive balance for his coming milestone. So, he/she can assume postural control in a shorter time.

Figure (1): this figure illustrate the dynamic standing frame

III-Results:

Thirty non ambulant children with spastic Diplegia participated in this study, five children were excluded for high absence rate. Children were subdivided into two matched groups. The first group was the study group who received a selected physical therapy program of balance training using standing frame fixed on balance board in addition to a selected physical therapy program, and the second group was the control group who received the selected physical therapy program only. Data obtained from both groups prior and following the treatment program regarding GMFM were statistically analyzed and compared. I. Pretreatment median values of GMFM of the two patient groups (study and control):were 33 and 38 respectively, recording no significant difference in the median values of GMFM pretreatment

between study and control groups (p = 0.64). II. Pre and post treatment median values of GMFM of study groupwere 33 and 57 respectively. Suggesting a significant increase in the median values of GMFM post treatment compared with pretreatment (p = 0.002). III. Pre and post treatment median values of GMFM of control groupwere 38 and 43.5 respectively. Suggesting a significant increase in the median values of GMFM post treatment compared with pretreatment (p = 0.001). IV. Post treatment median values of GMFM of the study and control groups revealed that the study group was 57 and that of control group was 43.5. Significant increase in the median values of GMFM post treatment of study group compared with the control group (p = 0.02) using Mann–Whitney U test. (Table 1, figure 2).

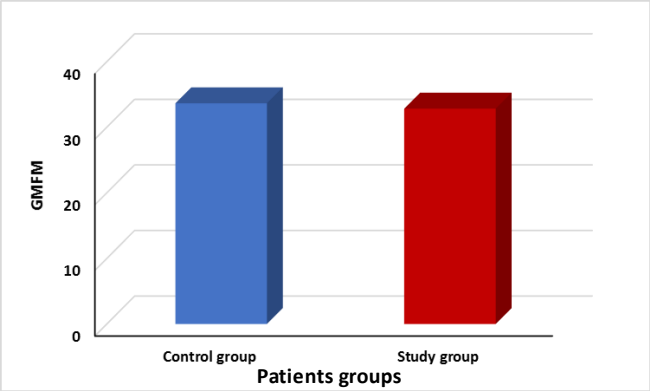

Figure (2): **Pre-treatment mean values of GMFM of the control and study groups.**

Table 2: ***post treatment mean values of GMFM between the control and study groups:***

	GMFM	**MD**	**t- value**	**p-value**	**Sig**
	$\overline{X}$ **±SD**				
Control group	40.25 ± 17.16	-15.75	-2.61	0.01	**S**
Study group	56 ± 12.8				

$\overline{X}$ **: Mean** **MD : Mean difference** **p value : Probability value**

SD : Standard deviation t value : Unpaired t value S : Significant

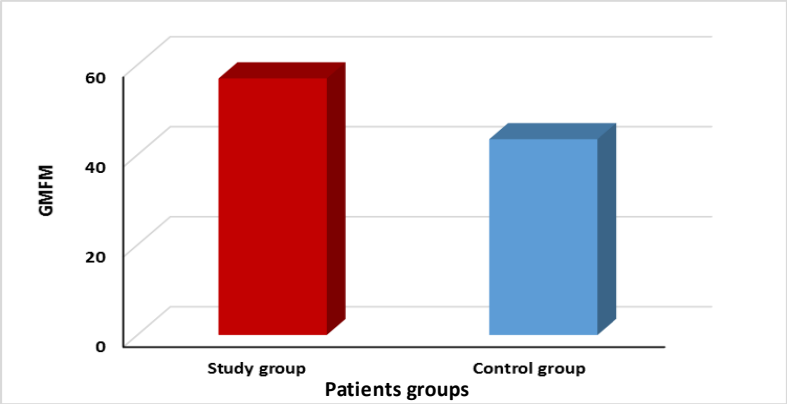

***Figure (3).*Comparison between post treatmentmean values of GMFM of control and study groups**

VI-DISCUSSION:

The present study was conducted to evaluate the effect of dynamic standing frame on gross motor function in children with spastic diplegic cerebral palsy. Non ambulant children were recruited for this study to uncover clearly the effect of using dynamic standing frame on gross motor function in non-ambulant spastic diplegia from standing position, before they can assume normally, will it promote improvement of gross motor function especially at kneeling and standing stages of motor development. There is a direct relation between decreased locomotorfunction and the limited capacity for participation, social and community interaction in CP children (14). Partial weight bearing therapy (unweighing) is a concept of rehabilitation that uses an external device to support a percentage of the patient's body weight allowing them to perform therapeutic activities in an upright position, proper biomechanics due to the control of center of mass in both horizontal and vertical direction (15). Considering the role of balance skills in improving motor function in children with spastic diplegia, emphasis on rehabilitation of balance skills is a significant step in improving

activities of daily living (16). Balance training is an important part of rehabilitation of CP children because it has been shown that there is a relation between constraints on balance control and functional limitations of CP children (17).This come in agreement with Hosseini and Ray (18) who stated that Vestibular stimulation is a sensory supplementary stimulation in order to increase arousal level, increase visual exploratory behavior, motor development and reflex integration in high risk infants and delayed children. Most recent researches accepted the importance of vestibular stimulation on other CNS structures. Schler is among the first professionals, who investigated the importance of the vestibular system in human development (19). He assessed the vestibular system integrator function in the central nervous system, and its role in the development of body image. Various studies agree with his findings. Most of them accepted the importance of the vestibular system in the development of movements, reflex integration, creation of eye movement,visual attention and development of exploratory behaviors with integration of arousal level. However, there is little research information accessible, for explaining this participation in the control and integration of upper level functions.Recent researches work on different sensory stimulations to help better neural development and one major complement is the vestibular stimulation. Those researches have been investigated and some show that controlled vestibular stimulation, have fruitful and positive effect on arousal level, visual exploratory behavior, motor development and reflex integration. Also, there is still a need for more applicable clinical researches and specifying the best kind of vestibular stimulation and the population that are the best receivers.

V-Conclusion:

Children who received early vestibular stimulation even before gaining ability of standing alone by using dynamic standing frame are able to control their balance faster. So it can besuggestted that dynamic standing frame is an effective

therapeutic tool for vestibular stimulation to improve balance and this improvement was reflected on gross motor function of children with spastic diplegic cerebral palsy.

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