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PHYSIOTHERAPY TECHNIQUES TO IMPROVE POSTURE AND BALANCE IN CEREBRAL PALSY- A REVIEW

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ABSTRACT

Cerebral palsy (CP) is the most common movement disorder in children that is associated with life-long disability and multiple impairments. The clinical manifestations of CP vary among children. CP is accompanied by a wide range of problems and has a broad spectrum. Children with CP demonstrate poor fine and gross motor function due to psychomotor disturbances. Poor balance control is known to be a major constraint in functional activities of daily living such as standing or walking, in which good functional balance is required in both static and dynamic positions. Maintenance of postural stability depends on continuous integration of the musculoskeletal and nervous system, which carries visual, somatosensory and vestibular information. To enhance balance and motor ability in the paretic leg in children with spastic hemiplegia, a therapeutic approach promoting weight-shifting to the paretic side and strengthening of paretic leg muscles is required. Postural stability is a key factor in keeping up with daily activities because it affects gross motor abilities, and it must be a part of any rehabilitative intervention in children with CP, to improve biomechanical functioning as a whole by progressively approximating specific ideals of posture and movement, rather than to treat particular symptoms. Physiotherapy can help the child with cerebral palsy in improving balance and posture.

***Key words:* Cerebral Palsy, trunk, vestibular, Swiss ball, virtual reality.**

INTRODUCTION

Cerebral palsy (CP) is the most common cause of childhood disability and is seen in 2–2.5 out of 1,000 births. The non-progressive lesion in the brain that causes CP has devastating effects on the musculoskeletal system.

Many children with CP have poor walking abilities and manipulation skills. One contributing factor to their problems with gait and reaching movement is poor balance control because the maintenance of stability is critical to all movements. Balance control is important for competence in the performance of most functional skills, helping a child to recover from unexpected balance disturbances, either due to slips and trips or to self-induced instability when making a movement that brings them toward the edge of their limit of stability. Reactive balance control is defined as the ability of an individual to recover from an unexpected threat to balance, such as a slip or atrip.

These effects, like spasticity, imbalance between agonist and antagonist muscles, and decreased voluntary muscle control, can result in contractures and deformities. Maintenance of postural stability depends on continuous integration of the musculoskeletal and nervous system, which carries visual, somatosensory and vestibular information. This integration is damaged in patients with CP due to its effects on both key systems, having a bad influence on postural stability. Postural stability is a key factor in keeping up with daily activities because it affects gross motor abilities, and it must be a part of any rehabilitative intervention in children with CP.

Children with CP show limited postural control due to injury to the central nervous system in the developing brain. In fact, poor balance control is known to be a major constraint in functional activities of daily living such as standing or walking, in which good functional balance is required in both static and dynamic positions. Diminished motor ability in the paretic leg causes weakening of the quadriceps, ankle plantar flexors and ankle dorsiflexors. To enhance balance and motor ability in the paretic leg in children with spastic hemiplegia, a therapeutic approach promoting weight-shifting to the paretic side and strengthening of paretic leg muscles is required.

Many children with CP have neuromuscular deficits, including the lack of motor control, abnormal muscle tone, impaired coordination, sensory problems, and impaired balance control. Balance control is imperative to all movements, and a major factor restricting functional ability is poor balance control.Impaired motor functions of the involved limbs, poor balance and postural asymmetry are critical factors that limit children with hemiplegic cerebral palsy (HCP) from performing routine daily activities.

FORCED USE THERAPY

Forced use therapy (FUT) can be provided during a 3-week, 6 h per day on 12 non-consecutive days. During the intervention, the children can wore a sling on the non-involved upper limb in order to immobilize it while they were engaged in many activities that implied either the upper limb specifically (arts and crafts, playing a musical instrument, drawing and cooking) or the whole body (gymnastics, collective sport). Participants are not specifically engaged in repetitive tasks and they did not receive other physical therapy treatments during the FUT period. The positive effect of wearing a sling on ML postural asymmetry could be explained by the mass redistribution imposed by the sling. Indeed, the sling requires keeping the uninvolved upper limb in a more medial position, which may lead to a medial transfer of the body's centre of mass.

REACTIVE BALANCE TRAINING

The effectiveness of intensive practice in reactive balance control on the organization of postural responses to balance threats in typically developing children just learning to stand independently. The effect of intensive practice in responding to balance threats created by a moveable platform on recovery of stability in school age children with CP. This type of balance training would improve reactive balance control in children with CP, specifically improving the performance variables. A reduction in both center of pressure movements during balance recovery and in time taken to stabilize balance after a balance threat. The training included 100 perturbations of about 4-6/min each (along with rest breaks), with platform movements in both anterior and posterior directions at different amplitudes (3-6 cm) and speeds (12-4cm/sec). The training differed from other intervention strategies in specifically focusing on reactive balance control during a short intensive period of training (5 days at 100 perturbations/day).

TASK-ORIENTED TRAINING

When a child had no change in any activity over a period of two minutes, the training program was applied to himor her. A child can be able to choose various activities during the child-centered task-oriented training program; a therapist take on the role of an assistant when a child wanted to perform an activity. However, a therapist provided verbal cues and physical activity guidance when a child showed abnormal or compensatory movement patterns during the training program.

SWISS BALL TRAINING

One set of trunk stabilization exercises was composed of ten repetitions of five different routines. Ten sets were completed in each exercise session with a two-minute break between sets. First, a subject was asked to sit on a ball while lifting one or both arms. Second, the subject sat on the ball with the feet (soles and heels) on the ground while bending the hip and knee joints at 90-degrees, and was then asked to maintain the trunk in an upright position for 20 seconds. Third, the subject performed pelvic tilt (anterior/posterior, left/right) and rotation exercises. Fourth, the subject placed the ball under his/her trunk while in a four-point kneeling position and lifted the arms and legs in the following manner: right arm with left leg and then left arm with right leg consecutively for five seconds. Fifth, with the subject in the prone position, the ball was placed beneath the feet and the hips were lifted for five seconds.

WHOLE BODY VIBRATION TRAINING

Whole Body vibration training (WBVT) was performed on the vibration plate. Each session consisted of three 3-minute bouts of training, with a 3-minute rest between them. Sessions were performed four times a week, over a 20-week period. Participants started with sessions of three1-minute bouts at 12 Hz, and both intensity and duration were gradually increased according to the response of individual participants. However, by the end of week 4, all participants were training at the prescribed protocol of 3 sets of 3 minutes at 20 Hz and 1 mm amplitude, four times a week. Majority of participants were training for2 minutes at 15 Hz by the end of week 1, for 3 minutes at 16 Hz by week 2, for 3 minutes at 18 Hz by week 3, and for 3 minutes at 20 Hz by the end of week 4. Training intensity was maintained at 20 Hz for the remainder of the intervention. Participants stood barefoot on the plate with feet apart (position 2–3) and in parallel, with knees slightly bent for the duration of training. An adjustable metal frame was used as an aid for those participants who had difficulty in standing on the plate over the course of training.

The participants' hands were mostly free during the training sessions. The frame was used in the beginning of the study until participants built up confidence and were able to safely support themselves during the vibration training. However, for the few participants with poorer balance (<10%), the frames were maintained at all times, so that it could be used to safely regain balance when necessary. Sessions at school were supervised by a member of our research team, while parents/caregivers supervised home sessions. Participants were asked to maintain a training diary to monitor compliance with study protocol. Data recorded in the diary included the date, intensity and duration of training, as well as any comments regarding adverse events, tiredness, or pain. A research team member also supervised the participants performing training at home once a week, in order to monitor progress and provide feedback/support for parents or caregivers.

TRAN CRANIAL DIRECT-CURRENT STIMULATION COMBINED WITH VIRTUAL REALITY TRAINING

A foam mat measuring 40 × 60 × 5 cm was used as a proprioceptive stimulus. Measurements were taken under four conditions: feet on the force plate with the eyes open; feet on the force plate with the eyes closed; feet on the foam mat with the eyes open; and feet on the foam mat with the eyes closed. Three 45-second measurements were taken under each condition, and the mean was used in the analysis. The order of the different conditions was randomized to avoid the possible effects of motor learning. Between measurements, the participants were given a one-minute rest period in the sitting position. Stabilometric evaluations were conducted in a single session prior to and immediately following the training protocol. The children first received an explanation of the procedures, remained at rest for 20 minutes. Two raters were in charge of the procedures to ensure blinding and there liability of the results. Rater 1 was in charge of placing the electrodes and the administration of tDCS (active or placebo). Rater 2 supervised the virtual reality mobility training. Both the children and Rater 2 were blinded to the allocation to the different groups.

The intervention consisted of a single session of tDCS using two sponge (non-metallic) electrodes (5 × 5 cm) moistened with saline solution. The anodel electrode was positioned over the primary motor cortex, following the 10–20 International Electroencephalogram System, and the cathode was positioned over the supra-orbital region on the contra lateral side. In the experimental group, a 1-mA current was applied to the primary motor cortex region for 20 minutes while the children performed the virtual reality mobility training. The device has a knob that allows the operator to control the intensity of the current. In the first ten seconds, the stimulation was gradually increased until it reached 1 mA, and it was gradually diminished in the last ten seconds of the session.

KINESIO TAPING

Kinesio Tex Gold was used for KT application while the children were seated in upright position. Tapes were prepared as I shapes and fixed to the acromioclavicular joint (the first 5 cm without stretching). Then, the tapes were stripped to the T12 obliquely with stretching and the last 5 cm without stretching. KT was applied bilaterally during 4 weeks and was changed in every 3-4 days.

STOCHASTIC VESTIBULAR STIMULATION

For each subject, the 5 cm x 10 cm electrodes were centered over the mastoid processes on both sides using methods described in our previous paper and described briefly herein. The skin surface at the electrode sites was cleaned and dried, and a layer of electrode gel was applied before placing the electrodes on the skin surface. Soft pads were then placed over the electrodes and held in place using an elastic strap that did not constrain head movements. This methodology was adopted to achieve a uniform current density and minimize any irritation at the electrode site during the delivery of the electrical stimulus to the skin. The impedance between the electrodes was confirmed to be less than 1 kΩ.

POSTURAL MOTOR LEARNING

Participants completed two visits on consecutive days. Visit 1 included: 1) familiarization perturbations, which included 4 perturbations in the forward and leftward direction, and 3 perturbations in both the backward and rightward directions, 2) a baseline test for stepping in response to mediolateral perturbations: 5 rightward and 5 leftward support surface perturbations (randomorder), and 3) the motor practice of forward-backward perturbations: 25 forward and 25backward perturbations (random order). The same perturbation sequence was administered to all participants. Participants were given breaks after every 10 perturbations, or more often if requested. Twenty-four hours after visit 1, participants returned to assess retention of improvement in forward-backward stepping, and generalization to medio-lateral stepping. Participants repeated familiarization and medio-lateral perturbations exactly as in day 1, followed by 10forward-backward perturbations (5 per direction, random order). These 10 forward backward perturbations were exactly the same size and sequence as the first 10 forward backward perturbations on day 1. Medio-lateral protective stepping was chosen as the generalization task because it is an important movement for fall-prevention. In addition, despite the relatively distinct nature of this movement from anterior-posterior stepping, generalization across tasks may be possible. Perturbations consisted of translations of the support surface. Forward translations of the support surface resulted in backward displacement of the center of mass and backward stepping responses. Thus, we will refer to “backward” perturbations as those resulting inbackward stepping responses, and “forward” perturbations as those resulting in forward stepping responses. Familiarization perturbations ranged from 9cm, 14.6cm/s to 15cm,56cm/s. All lateral perturbations were 15cm, 21cm/s. All forward-backward practice perturbations were 15cm and 56cm/s, with an average acceleration of 2.25m/s2.

HIPPOTHERAPY

In physical therapy, multidirectional movements of the horse are utilized in gait training, balance, posturalcontrol, strengthening, and increasing rangeof motion. Improvements in grossmotor skills, and functional activities have been reportedin disabled children.

In theory, the horse sets up patterns of perturbations that its rider must master in order to maintain balance and feel comfortable and secure. Sterba et al. in 2002 had 17 children with CP ride for 1 hour ⁄ week for 18 weeks and noted improvement on the GMFM, specifically in the walking, running, and jumping portions. This was supported in2004 by Cherng et al. who noted that the improvements lasted at least 16 weeks after the therapy. Recent review shave concluded that hippotherapy is effective in improving motor skills. Furthermore, participants report that it isfun and, when done in the community, increases socialization, which is an implicit goal of the International

Classification of Functioning, Disability and Health as detailed by the World Health Organization. Moreover, hippotherapy can easily be carried over to adulthood. Other recreational activities have not been studied, but wheelchair sports and adaptive skiing offer other venues for research into how certain sporting activities might promote health over the longer term.

Hippotherapy intervention protocols vary between studies in intensity and duration. In the studies cited, session length ranged from 30 minutes to 1hour with a frequency ranging from 1–2 sessions per week and the total duration of horseback riding ranged widely from 8 min and 26 hours. According to a recent systematic review, a weekly 45-min session hippotherapy for 8–10 weeks was correlated with positive effects on gross motor function in children with CP. Theseresults, they administered 45-minutes sessions twice per week for 8 weeks in the study. Hippotherapy was performed at the riding center in Seoul Race Park of the Korea Racing Authority. The sessions were conducted by a trained occupational therapist accredited by the American Hippotherapy Association while the horse was led by a trained assistant. A volunteer walked along either side of the horse to assist the child. The therapist followed target objectives aimed to develop the child's sensor motor and perceptual-motor skills. The child was seated astride the horse wearing a helmet and was encouraged to perform various activities designed to emphasize movement in a forward and upward reaching direction to encourage active postural control, trunk strength, balance and trunk/pelvic dissociation.

CONCLUSION

Postural problems in children with CP and the path physiology underlying these problems are presently fairly well described. On the other hand, we have little 'high-level' evidence on how different interventions can affect these problems. Therapeutic attention to promote motor performance in sitting focuses on adaptive seating, tilting of the support surface, and ample, variable training in motivating settings. The challenge facing us now is to provide evidence about the efficacy of specific treatment approaches facilitating that children reach an optimal level of functioning in daily life.

REFERENCES

1. C. Elanchezhian, P. SwarnaKumari. Physical Rehabilitation Techniques to Improve Hand Function in Cerebral Palsy, Indian Journal of Applied Research, May 2017; 7(5): 377-379
2. OzgeKenis-Coskun, EsraGiray, BeyhanEren, OzlemOzkok, EvrimKaradag-Saygi. Evaluation of postural stability in children withhemiplegic cerebral palsy. J. Phys. Ther. Sci. 2016, 28: 1398–1402.

3. ValeskaGatica-Rojas, Ricardo Cartes-Velasquez,Guillermo Méndez-Rebolledo, Felipe Olave-Godoy, David Villalobos-Rebolledo.Change in functional balance after an exercise program with Nintendo Wii in Latino patients with cerebral palsy: a case series.J. Phys. Ther. Sci. 2016, 28: 2414–2417.
4. Su-Ik Park, Mi-Sun Kim, Jong-Duk Choi. Effects of concentric and eccentric control exercise on gross motor function and balance ability of paretic leg in children with spastic hemiplegia.J. Phys. Ther. Sci. 2016, 28: 2128–2131.
5. Laurent Ballaz, Anne-FabienneHuffenus, Celine Lamarre, Louise Koclas andMartin Lemay.Effect of forced use therapy on posture in children withhemiplegic cerebral palsy: a pilot study.J Rehabil Med 2012; 44: 268–271.
6. Marjorie Hines Woollacott and Anne Shumway-Cook.Postural Dysfunction during standing and walking in Children with Cerebral Palsy: What Are the Underlying Problems and What New Therapies Might Improve Balance? .Neural Plasticity, 2005; volume 12:2-3.
7. Myoung-Kwon Kim.The effects of trunk stabilization exercise using a Swiss ball in the absence of visual stimulus onbalance in the elderly.J. Phys. Ther. Sci. 2016; 28: 2144–2147,
8. Daniel S. Peterson, Bauke W. Dijkstra, and Fay B. Horak,Postural motor learning in People with Parkinson’s disease.J Neurol. 2016 August; 263(8): 1518–1529.