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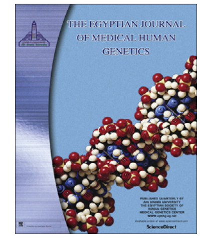

ORIGINAL ARTICLE

Integrated effect of treadmill training combined with dynamic ankle foot orthosis on balance in children with hemiplegic cerebral palsy

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KEYWORDS

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Abstract *Background and purpose:* Maintaining balance is a necessary requirement for most human actions. Most cerebral palsy children, who constitute a large portion in our country, continue to evidence deficits in balance, co-ordination, and gait throughout childhood. So, the purpose of this study was to determine the combined effects of treadmill and dynamic ankle foot orthosis on balance in spastic hemiplegic children.

Subjects and methods: Thirty spastic hemiplegic children from both sexes ranging in age from 7 to 11 years represented the sample of the study. The degree of spasticity ranged from 1 to 1+ according to the Modified Ashworth Scale. They were assigned randomly into two groups of equal number (A and B). Each child in the two groups was evaluated before and after 3 months of treatment for detecting the level of lower limb performance using the Peabody Developmental Test of Motor Proficiency and Stability indices using Biodex instrument system.

Both groups received a designed physical therapy program for treatment of hemiplegic cerebral palsy children for 60 min, in addition group B received treadmill training with dynamic ankle foot orthoses for 30 min.

Results: Significant improvements were observed in all measuring variables when comparing the pre and post-in the same group. Comparing the post-treatment variables, significant difference is revealed in favor of the group (B).

Conclusion: The obtained results strongly support the combined effect of dynamic AFO with treadmill training as an additional procedure to the treatment program of hemiplegic cerebral palsy children.

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1. Introduction

Cerebral palsy (CP) is a group of permanent disorders of the development of movement and posture, which are attributed to non progressive disturbances that occurred in the developing fetal or infant brain [1]. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition communication, and behavior. Secondary musculoskeletal impairments, pain, and physical fatigue are thought to contribute to changes in motor functions in children with CP [2]. Spastic hemiplegia accounts for more than a third of all cases of CP, and the resulting impairments to extremities affect functional independence and quality of life [3]. The most common patterns of spasticity during standing include flexion of the head toward the hemiplegic side and rotation. So that the face is toward the unaffected side and the upper limb is in flexion pattern with the scapula retracted and the shoulder girdle depressed [4]. The diagnosis of CP is based on a clinical assessment, and is typically based on observations or parent reports. Parents complain that their children had delayed motor milestones, such as sitting, standing, walking that play an important role in assessment of these cases. Evaluation of posture, deep tendon reflexes and muscle tone, particularly among infants born was done prematurely [5]. The treatment approaches used in management of cerebral palsy are neurodevelopmental treatment, sensory integration, electrical stimulation, constrained induced therapy and orthosis [6]. Balance control is important for performance of most functional skills and helping children to recover from unexpected balance disturbances due to self-induced instability [7]. Difficulties in determining individual causes of balance impairment and disability are related to decreased muscle strength, range of movement, motor coordination, sensory organization, cognition, multisensory integration and abnormal muscle tone [8].Treadmill training was used for children with cerebral palsy to help them to improve balance and build strength of their lower limbs so they could walk earlier and more efficiently than those children who did not receive treadmill training [9]. The treadmill stimulates repetitive and rhythmic stepping while the patient is supported in an upright position and bearing weight on the lower limbs [10]. A positive correlation exists between balance impairments and decreased lower-limb strength. In addition, poor trunk controls negatively influence overall balance [11]. Splinting is commonly used by both physical and occupational therapists to prevent joint deformities and to reduce muscle hypertonia of hemiplegic upper limbs after stroke [12]. Orthoses are commonly used to improve and correct the position, range, quality of movement, and function of a person's arm or hand [13]. It is proposed that inhibition results from the application of splint can be due to altered sensory input from coetaneous and muscle receptors during the period of splint or cast application. Immobilization is applying gentle continuous stretching of the spastic muscle at submaximal passive range of motion [14]. Ankle–foot orthoses (AFOs) are frequently prescribed to correct skeletal misalignments in spastic CP, and to provide a stable base of support which helps in improving the efficiency of gait training [15]. Dynamic AFO is a dynamic orthosis (articulated), which is used to facilitate body motion to allow optimal function [16]. A dynamic AFO provides subtalar stabilization while allowing free ankle dorsiflexion and free or restricted plantar flexion· So, dynamic ankle foot orthosis may be effective to gain balance and proper body alignment. The present study aims to evaluate the effect of the dynamic ankle–foot orthosis on standing balance of the spastic hemiplegic child.

2. Subjects, randomization and methods

2.1. Subjects

Thirty hemiplegic CP children participated in this study from both sexes. They were selected from the pediatrics out-patient clinic of the Faculty of Physical Therapy, Cairo University. Their ages ranged from 7 to 11 years old. They were divided randomly into two groups A&B: *Group A:* included 15 children (10 boys and 5 girls) with mean age of 9.801 ± 0.77 years. They received a designed physical therapy program for treatment of hemiplegic cerebral palsy children for 1 h, *Group B:* included 15 children (10 boys and 5 girls) with mean age of 9.401 ± 0.69 years, and they received the therapeutic exercise program for treatment of hemiplegic cerebral palsy children for 1 h as group A in addition to exercising on treadmill with the ankle–foot orthosis for about 30 min. The subjects were selected according to the following criteria: (1) Spasticity grades ranged from 1 to +1 according to modified Ashworth scale [17]. (2) They were able to follow simple verbal commands included in the tests. (3) All subjects did not have fixed deformity of both lower limbs. (4) All subjects were able to stand with support. Exclusion criteria (1) shorting or contracture (2) cardiovascular diseases, (3) surgery within the previous 24 months, (4) sensory defensiveness, and (5) inability to follow instructions. All procedures involved for evaluation and treatment, purpose of the study, potential risks and benefits were explained to all children and their parents. The work is carried out in accordance with the code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. Parents of the children signed a consent form prior to participation as well as acceptance of the Ethics Committee of the University was taken.

2.2. Randomization

Randomization process was performed using closed envelopes. The investigator prepared 30 closed envelopes with each envelope containing a card labeled with either group A or B. Finally, each child was asked to draw a closed envelope that contained one of the two groups.

2.3. Methods

2.3.1. For evaluation

Stability indices and gross motor function were evaluated before and after three successive months of treatment, using Biodex Stability System and Peabody developmental motor scale II). A familiarity session occurred prior to the test session. This session was particularly necessary for the children to ensure their comfort with the research team and protocol. On this session, participant practiced Biodex Stability System and Peabody developmental motor scale II).