The assessment of influence gait training using active orthoses on balance of children with cerebral palsy

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1. Introduction

Cerebral palsy is the result of damage the central nervous system in early brain development. Motor disorders resulting from damage to the maturing brain reflect the wide variety of different cortical and subcortical injuries occurring in the first year of the child life [1]. In contrast to healthy children, postural-locomotion patterns of children with cerebral palsy is characterized by high variability. Abnormalities observed in these children are due to improper control of movements of the child and is the result of brain damage and the compensating mechanisms. Primary symptoms of damage the central nervous system include: lack of selective motor control (particularly in the distal parts of the lower limbs), the influence of primitive reflexes, weakness of postural reflexes, sensory disorders, improper distribution and size of postural tension and imbalance of muscle activity between the agonist and antagonist muscles. The effect of these factors is the occurrence of irregular forces acting on the musculoskeletal system, which contributes to the onset of secondary symptoms: contractures, bone deformities and the development of joints luxation or subluxation. These changes depend on the type and severity of central nervous system damage and intensifies with age. Compensation mechanisms cause the perpetuation of abnormal postural-locomotive patterns, belonging to the tertiary symptoms. The aim of this study is to assess the balance, including foot loading symmetry, in the group of children with spastic diplegia treated using active orthoses [2].

2. Material and Methods

In the study participated children with cerebral palsy aged 6-14 years. Qualified: children with spastic diplegia in age from 7 to 13, standing alone, on level II-III in GMFCS classification, without disorders of higher mental functions. Not qualified: children treated with botulinum toxin in less than 6 months, children treated surgically in less than 1 year. Exclusion criteria were also active drug-resistant epilepsy, disparities in the length of the lower limbs larger than 2 cm, fixed contractures, bone and joint deformities, bone-articular instability (joints dislocation), baclofen therapy using an implanted infusion pump, plaster inhibit bandages during the last 6 months, significant amblyopia and hearing loss, inflammation of the skin and open skin lesions around the trunk or limb, contra-indications for training on a treadmill, the lack of cooperation from the patient and the lack of consent by the patient or guardian. For this study qualified 18 children, divided at random into two groups. Study group consisted of 9 children, and a control group of 5 children (4 children resigned from the participation in the project before its completion).

The study was performed twice, before and after the treatment. Estimated balance with open and closed eyes, using the stabilometric Zebris platform. Multifunctional platform for measuring the strength works with the 1504 capacitive force sensors organized in a matrix 32 x 47 cm. It allows for analysis of static and dynamic force and pressure distribution underfoot. The length of motion path, confidence ellipse area, horizontal and vertical deviations of COG (Center Of Gravity), and percentage values of forefoot and barefoot loading was analyzed. Children from the study group used active orthose Locomat from Hocoma company and realised a program based on individual exercises with a physiotherapist. Children in the control group participated only in individual exercises with the therapist. Children with test and control groups participated in 20 therapeutic sessions. Total time taken to exercise in both groups was the same. Locomat is a device which allows the walking training in terms of dynamic unloading (facilitation?) with the gait pattern simulation for the lower limbs with the possibility of setting parameters of gait (velocity, step length). Training allows for precise execution of the maximum number of repetitions of cycles in a normal gait pattern, which is an essential element in the rehabilitation of lost or impaired gait function. In addition, you can prevent the formation of compensation and pathological patterns in the early stages of improvement in neurological diseases.
3. Results

In the group of children categorised for exercises using active orthose Lokomat in the initial examination (opened eyes) the mean value of the area of the migration of the centre of support was (Confidence ellipse area) 947.1 mm² and reduced to 758.0 mm² in the checkup after physiotherapy. The difference between results wasn’t significant statistically (p= 0.6784). During the attempt with eyes closed average size of the area of the surface area (Confidence ellipse area) in the initial examination was higher and was 1145.1 mm² however in the final examination reduced up to 251.0 mm² (p= 0.0152 *). In the attempt with eyes closed significant reduction length stated in the mean of value of the migration of the centre of surface area (Total track length) (0.0077 * *), of average of the amplitude of sway in the frontal plane (Vertical deviation) (0.0209 *) and of average of the width area (Confidence ellipse width) (p= 0.0284 *). Into analogous how for the examined group the way was described distribution of the value of checked parameters in 5 personal control group. By such a small group, getting significant statistically effects of therapy was very difficult. None of parameters in the control group both in the attempt with opened and closed eyes is keeping steady in the significant way statistically as a result of the physiotherapy.

In comparing the level of effects of physiotherapy (expressed as differences in the measurement in the initial and final examination) in the examined and test group a significance of differences was assessed with the Mann-Whitney test , applied in the version for little attempts. They didn’t state characteristic statistically of differences in effects of the studied and test physiotherapy of the group – for no parameter measured by opened eyes. In examining with eyes closed, statistically characteristic differences in effects of therapy were stated for the total area and the total length of the path.

In the examination assessed also symmetry of load feet (LAFT - RAFT [%]) and with studied parameters. In examining with opened eyes were stated significant relations between symmetry of load feet and confidence ellipse height, confidence ellipse area and horizontal deviation. Direction of correlation is surprising, because decrease in the difference between the right and left foot (improvement in the symmetry) meant certain height (or at least a smaller decrease) of parameters. In the attempt with its eyes closed the significant relation was stated between the symmetry of load feet and Total track length (R= 0.58, p= 0.0289 *).

4. Discussion

With one of conditions of independent functioning of the child with cerebral paralysis (CP there is a minimum level of the efficiency especially in the posture, the locomotion and manual activities. The balance and the stability of the posture of children with CP being able independently to stand and walk to a considerable degree are disturbed [3]. For the purposes of the rehabilitation of the CP children are a lot of methods and manners of treated. Automatic orthosis (Lokomat) is one of new devices inserted into the rehabilitation [4]. Borggraefe and others assested effects of exercises with the application automatic orthosis Lokomat showed in the group with CP children significant improvement within the balance, the walk and the general motoric [5]. The aim of this study was assessment of the balance of CP children randomly selected to the group exercising with the application of the automatic orthosis and groupof exercising conventionally . Final results of examinations, in attempts with eyes closed, showed the significantly statistically greater improvement in the examined group. The achieved result can suggest the improvement in the control of the vestibular system, because final results by opened eyes aren’t improving significantly statistically. Exercising from the examined group they also got the improvement in the symmetry of load lower limbs, and together with the increase in the symmetrical a total road became smaller sway of centre of Gravity at the attempt with closed eyes. The examination is pointing that of exercising with the application automatic orthosis can have the beneficial influence on the improvement balances of children as well as more further analyses are necessary of which an assessment of the impact of exercises will be a purpose for the change of locomotive functions.

References