Artigo Original

A Influência da Pulseira Estabilizadora em Uma Criança com Paralisia Cerebral Coreoatetóide.

The Influence Of The Use Of Stabilizer Bracelet In A Child With Choreoathetoid Cerebral Palsy

Stabilizer Bracelet In Choreoathetoid Cp

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Resumo

Introdução: O uso da pulseira estabilizadora é frequente no tratamento de distúrbios de movimento para fortalecer os músculos e ajustar coordenação. Ainda persistem dúvidas em relação à utilização de cargas para diminuir movimentos involuntários e as melhores cargas e posicionamentos.**Objetivo:** Avaliar a influência da pulseira estabilizadora na cinemática e nos parâmetros espaço-temporais em movimentos planares realizados pelo membro superior. Método: Uma criança, que apresenta diplegia com componente coreoatetóides devido a paralisia cerebral espástica,e uma criança controle sem paralisia cerebral, mesmo sexo, feminino e 7 anos de idade, foram submetidas à análise de movimentos em relação ao deslocamento, velocidade, aceleração linear e o cálculo do erro quadrado médio (MSE) com e sem a pulseira estabilizadora com cargas de 25, 50, e 75% da carga máxima suportada. **Resultados:** Após a compararação dos dados entre os sujeitos, foi observada diferença entre paciente e controle em todas as situações e variáveis. Uma comparação inter-individual, utilizando 25% da carga máxima apresentou a menor diferença com o EQM. **Discussão e Conclusão:** Esta opção terapêutica é de baixo custo, fácil aplicação e não interfere na estética do indivíduo. Portanto, os fisioterapeutas podem prescrever esta modalidade para atividades que exigem maior controle do membro superior, porque para o caso estudado os movimentos dos membros superiores foram mais eficientes com o uso da pulseira estabilizadora.

Palavra-chave: Paralisia Cerebral, Cinemática, Biomecânica, Técnicas de Movimento Exercício, Reabilitação

Abstract

Introduction: The use of stabilizer bracelet is a frequent treatment for movement disorders to strengthen muscles and adjust coordination. Still questions remain regarding the benefit of using loads to decrease involuntary movements and the best load and placement. **Objective:** To measure the influence of the stabilizer bracelet on the kinematics and spatiotemporal parameters in planar movements performed by the upper limb. **Method:** One child, who has the spastic diplegy type of cerebral palsy with choreoathetoid component, and a control child without cerebral palsy, both female and 7 years old, were subjected to analysis of movements in relation to displacement, velocity, linear acceleration, and the calculation of mean square error (MSE) with and without use of stabilizer bracelet with loads of 25, 50, and 75% of the supported maximum load. Results: After comparing data between subjects, a difference was found between patient and control in all situations and variables. An inter-individual comparison using 25% of the maximum load showed the smallest difference with the NDE. **Discussion and Conclusion:** This therapeutic option is low cost, easy to apply, and does not significantly interfere in the aesthetic of the individual. Therefore, physiotherapists may prescribe this for activities that require greater control of the upper limb because for the case studied the upper limb movement was more efficient with the use of the stabilizer bracelet.

Keyword: Cerebral Palsy, Kinematics, Biomechanics, Exercise Movement Techniques, Rehabilitation

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INTRODUCTION

For years, Cerebral Palsy (CP) has been studied by various disciplines in search of its etiology and classification[1,2,3,4].

Knowledge of genetics and technological advancements have made it possible to diagnose, monitor developments, and promote improved quality of life of these patients whose disorders of posture and movement restrictions are caused by non-progressive changes that occurred in the fetal or infant brain. Moreover, the motor disorders of CP are often accompanied by sensory changes in cognition, communication, perception, behavior, or convulsive crises[4].

Often, individuals with physical disabilities have involuntary movements associated with sequelae. These undesirable movements occur without intention or planning. Muscle tone spasticity is the most common, followed by changes in the lateral system activator, with a strong reaction with the blood group incompatibility, the Rh factor, and hyperbilirubinaemia[5]. To minimize the difficulties of children with CP and improve their performance in activities of daily living (ADL's), physical therapists commonly use a stabilizer bracelet on the forearm to decrease involuntary movements. In this context, the use of weight can help improve treatment by stimulating the child's potential[6].

The stabilizer bracelet is frequently used to treat this type of movement disorder, with the purpose of muscle strengthening and movement coordination adjustment[6]. However, questions still remain as to the benefit of using load to decrease involuntary movements, what load is most appropriate, and whether should be placed on the proximal or distal region of the member.

OBJECTIVE

Measure the stabilizing influence of the bracelet on the kinematics and spatiotemporal parameters in planar movements made by a child, who has the spastic diplegic type of CP with Choreoathetoid component, and compare it with a control subject.

CAUSUISTIC AND METHODS

Subjects

The two volunteers were both seven years old and female. One had been diagnosed with spastic diplegic type of CP with Choreoathetoid component and the other had no neurological deficits.

The inclusion criteria stipulated that they should both be able to voluntarily move the upper limb during the performance of the task; understand verbal commands, and have no visual impairment.

The exclusion criteria of this study were deformities in the joints of the upper limbs rheumatic diseases, associated orthopedic and neurological disorders, or has undergone surgical procedures on the upper limbs.

The study was conducted at the Laboratory for the Study of Movement, Physiotherapy Clinic and approved by the Ethics Committee under nº 299/07.

KINEMATICS ANALYSIS

Kinematic analysis involved the measurement of the movements in relation to displacement, velocity, and linear acceleration. This analysis was accomplished through studying film and computer analysis of motion in two dimensions, consistent image capture, formatting of the frames, and graphical interface.

To capture images of the upper limb movement, a system of reflective tags were placed on predetermined anatomical points on the surface of the skin. These marks become the anatomical points that could be easily identified in the scanned images.

Before starting the movement, participants were instructed to put their hand on the starting point (P1) and then perform a linear movement to the end point (P2).

Points P1 and P2 were identified on a drawing format "square" made with reflective tape. Points were placed at a distance of 35 cm. For marking the body segments, a reflective tape was attached on second, third, and fourth fingers of the child for accurate measurement of the motion's parameters (Figure 1).

After preparation of the segment, the task of movement was performed five times, first without using the bracelet and then using the bracelet with different loads.

The loads used in the bracelet were made by calculating the maximum resistance (MR) prescribed by McArdle, Katch and Katch[7]. A load was employed in which the volunteers were able to perform the movement in total amplitude for five repetitions, after this, the weight was gradually increase until the maximum weight resistance was reached. To avoid muscle fatigue of the volunteers, a calculation of the MR and oriented movements were performed in three progressive series of 25%, 50%, and 75% load of maximum resistance.

PROCEDURES FOR DATA ANALYSIS

The images were imported and analyzed by the MaxTRAQ ® program, version 1.91, 2D. The data were further processed by Maxmat ® 3.5 demo version that generated the results and graphs and exported the data for the extended ASCII files. The generated files were then analyzed statistically using the GraphPad Prism ®.

Quantitative analysis of data was obtained in the records of the kinematic moments of assessment: without the use of weights and using weight about 25%, 50%, and 75% of maximum load. All movements were performed under gravity.

For kinematic analysis, a third-order polynomial to represent the trajectories and velocities during the experiment was estimated. To know the velocities as well as the initial and final accelerations are zero, we can determine the constants a0, a1, a2 and a3 of the following polynomial.

$$X(t) = a_0 + a_1 t + a_2 t^2 + a_3 t^3$$

Initial conditions in $t = t_i$ e $t = t_f$:

$$\frac{dx(t)}{dt} = 0$$

$$\frac{d^2x(t)}{dt^2} = 0$$

The calculation of the average trajectory of each volunteer was a series of five trajectories.

To evaluate the effects of proposed charges and additional loads (masses) we decided to use the calculation of Mean Square Error (MSE).

Defining the instantaneous error as:

$$e_i = x_i - x_i$$

Where:

x_i desired trajectory

x_i : trajectory performed

Mean square error (MSE):

$$E = \frac{1}{N}\sum_{i=0}^{N-1} e_i^2$$

We decided to use the MSE as an index of quantitative assessment for motor control in linear and angular movements. However, this study did not aim to evaluate the angular movements.

In addition, MSE was also chosen to calculate the mean and standard deviation of the displacements, velocities, and accelerations of the five attempts in the no-load, 25%, 50%, and 75% conditions, making comparisons between the control subject and the clinical case.

RESULTS

The results are represented in the graphs and table below. Table 1 contains mean and standard deviation of five times data task comparing the kinematic analysis and spatiotemporal parameters between control and clinical situations with no load, 25%, 50%, and 75% load.

The relative position of the hand of the clinical case and control during the task without load, 25%, 50%, and 75% load, respectively, are on the figures 2, 3, 4, and 5.

DISCUSSION

Strategies of rehabilitation in physical therapy can no longer be used without strong and solid scientific support[8,9,10]. In an attempt to begin research on the effect of the using wrist stabilization in patients with cerebral palsy and involuntary movements, the planar motion and return of items posted for a distance of 35 cm, with and without the use of the stabilizer bracelet and with different loads for kinematic analysis of movements, was study.

In daily practice, many therapists use this resource; however, there has been no study to date published in journals indexed in electronic databases with results that quantify this effect in the rehabilitation process.

The initial hypothesis was that use of the bracelet with applied load on the distal forearm could reduce the involuntary movements presented by patients and thereby improve motor control during the task requested.

In order to compare not only power but also understand how load application influences the functional movement, a normal volunteer was used as control in the experiment. Thus, we could study the volunteer with CP individually and comparatively.

According to Lucareli et al[6] (2009) and the use of weights makes hand-mouth coordination easier. Therefore, in an attempt to reduce involuntary movements, bracelets with varying loads could be used to improve ADL's.

Mackey et al. in a study with patients with CP, using the stabilizer bracelet to reduce the range of motion caused by tone fluctuation, observed that the movement became faster and more efficient while typing. In our study, we observed a reduction of both the velocity in all situations evaluated, corroborating Lucareli et al[6] (2009), which reports that the rate of movement is related to the weight applied.

Muscle fibers shorten at a specific speed or quickness while developing the force used to move a segment or external load. The muscles create an active force that is equal to the load. The active force is adjusted by increasing the speed of contraction. With high loads, the muscle adjusts the active power by reducing the speed of shortening, which produces a relationship between the speed of contraction and the load moved. The higher the load, the lower the speed of contraction and the reverse also applies.

Shumway-Cook and Woollacott[11] reported that the ability of the scope involves the movement of the upper limb in space, promotes postural stability, which is extremely important for the gross motor skills like crawling, walking, regaining balance and protecting the body from damage in cases inevitable fall, and fine motor skills, used for activities of dressing, feeding, personal hygiene, and writing. Our study showed that the use of the stabilizer bracelet can facilitate the movement range of patients with CP and this may influence their daily activities, leaving it more harmonics.

Forsström and Von Hofsten[12] studied children with CP, ataxic and athetoid types, and observed movement that consumed more time in the transport of objects when compared with children without the disability. However children with disabilities could extended toward the object and pick it up, even when the target was moving quickly, which suggests that when planning to reach out, the children are able to offset the deficits that result in slow times of movement. The movement can be directed with sufficient time to the target, so they can maintain the accuracy for the range, even with their movement disorder.

According to Konczack et al[13], Konczack & Dichgans[14] patients with a variety of neural diseases, the movements of outreaching out are characterized by multiple joint coordination, and that this leads to abnormal trajectories of motion. Our study confirms that the child with CP who performs movements of reaching out showed an abnormal trajectory compared with the control child, but improved her motor with the load application. In this study, the use of even 25% of the maximum load was more efficient from the standpoint of the task applied to the patient when compared to the control case.

The process of motor programming is achieved by suprasegmental centers resulting in a descending motor command that is known as central command. In the performance of a movement, that signals is sent to the lower neural centers (brainstem and spinal cord) and back to the centers as a suprasegmental shooting corollary to assist in the interpretation of afferent information that arrives. This shot, which projects to the primary somatosensory cortex, provides the basis for the sense of effort.

The sense of effort is a sensation that indicates the effort required to generate specific muscle strength, in our case the linear displacement. This information is independent of the mechanisms that impair the ability of muscle to exert force. In other words, we can say only that one learns when one increases the command down before one has the perception of the task[15]. Thus, we can infer that in the case studied the use of the load made the subject increase the neural firing and only then realized performance.

The linear movements analyzed in this study refer to a major functional movements developed with the upper limbs. Kinematic analysis revealed that the subject performed movements better when compared to the proposed independent control of the load used.

More importantly, the use of 25% of the maximum load, which was closest to the normal movement of the control subject without load, is, therefore, the best treatment option for this patient.

In therapeutic situations, simply changing the motion and the apparent improvement in the movement pattern shown by the patient would be sufficient for the use of any of the loads. Now this is known it is desirable and possible to determine the best treatment option.

This result may not be reproducible and applicable in other patients, nor has the effect of prolonged use of the bracelet in the therapeutic process been tested. After training, will the removal of the load frame harm the patient's movement? Or is it possible to make the patient able to adapt and improve motor control of upper limb, thus bringing a lasting benefit? Is it necessary to increase the load for a certain training period?

At this time we can say that the appeal of this method is it's low cost, easy of application and insignificant interference in the aesthetic look of the individual. Thus, it may be prescribed by physiotherapists for activities that require greater control of movement of the upper limb. Because for the case studied, movement of the upper limb was more efficient with the use of the stabilizer bracelet.

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Table 1. Comparison of the kinematics analysis and spatiotemporal parameters between control and clinical case in situations without charge, 25%, 50%, and 75% load.

Parameters	Control				Clinical Case			
	No Load	*25%*	*50%*	*75%*	No Load	*25%*	*50%*	*75%*
Displacement (cm)	33.4 ± 3.1	34,4 ± 2.9	30.4 ± 2.7	30.9± 6.1	31.4 ± 5,1	28.6 ± 2.7	37.4 ± 3.1	28.6 ± 2.7
Speed (cm/s)	3.12 ± 0.2	2.9 ± 0.3	2.2 ± 0.2	2.1± 0.5	0.62 ± 3.1	1.8 ± 0.4	3.1 ± 0.3	1.8 ± 0.4
Acceleration (cm/s^2)	3.47 ± 0.3	2.7 ± 0.4	1.9 ± 0.3	18.8± 0.65	2.77 ± 3.7	12.9 ± 0.5	1.5 ± 0.6	12.9 ± 0.5
Mean Square Error	**0.047**	**0.067**	**0.082**	**0.072**	**0.127**	**0.042**	**0.054**	**0.072**

Figure 1. Schematic of the desired trajectory and the executed trajectory.

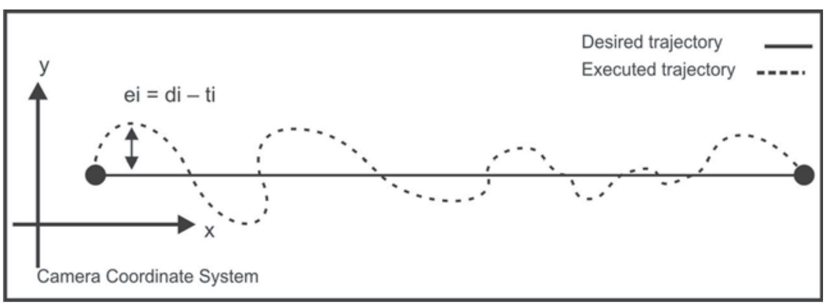


Figure 2. Relative position of the hand of the clinical case and control during the task without changes.

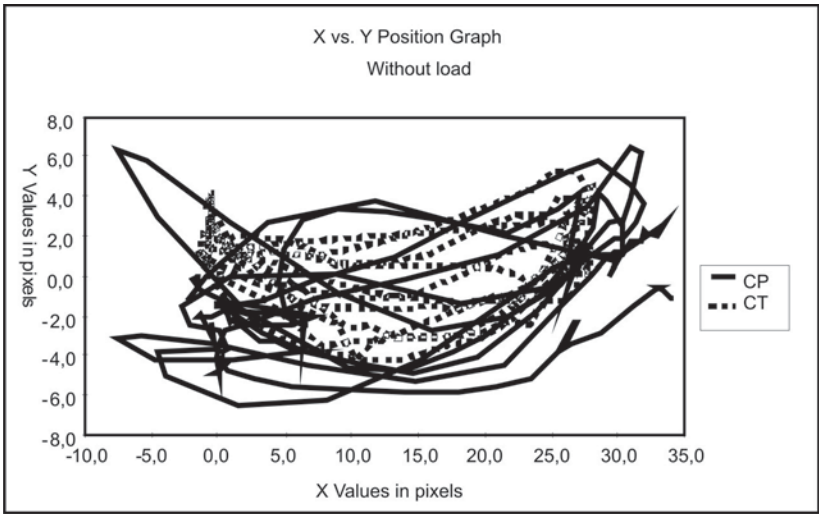
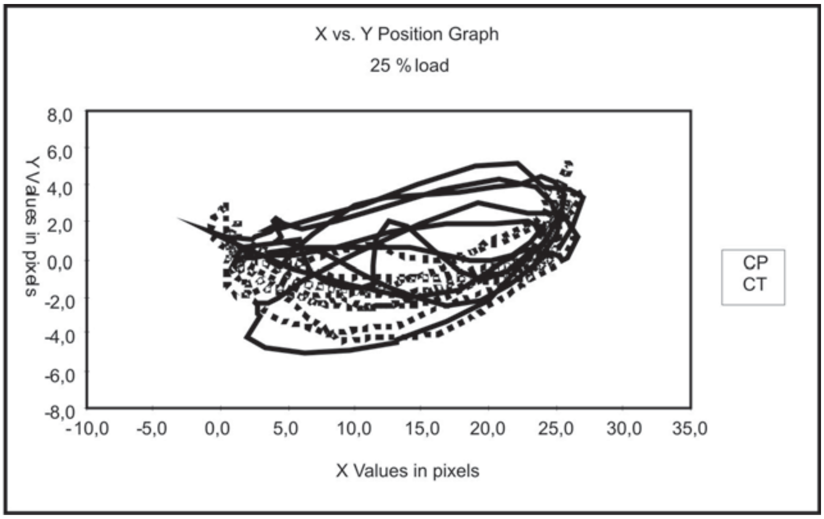
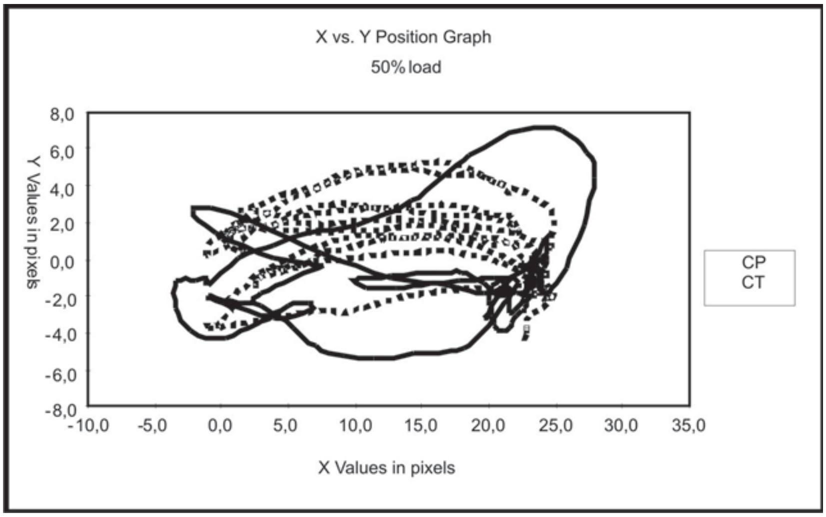


Figure 3. Relative position of the hand of the clinical case and control during the task with 25% load.



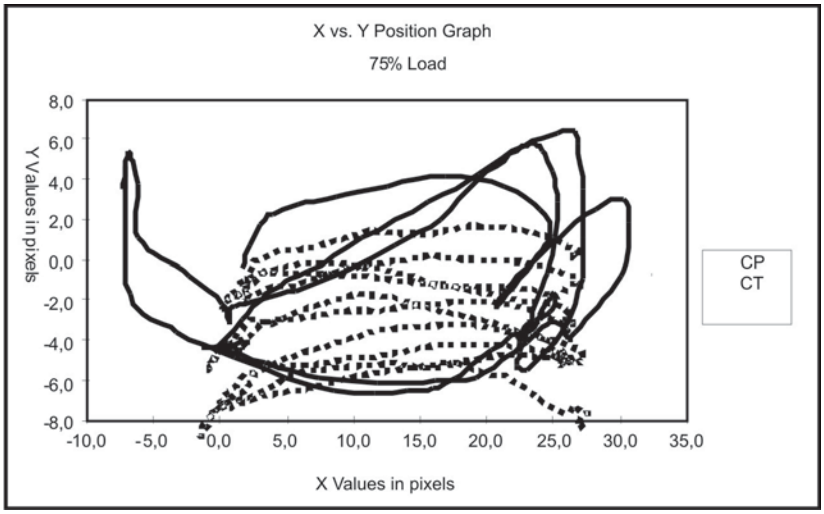
CP: Cerebral Palsy; CT: Control

Figure 4. Relative position of the hand of the clinical case and control during the task with 50% load.



CP: Cerebral Palsy; CT: Control

Figure 5. Relative position of the hand of the clinical case and control during the task with 75% load.



CP: Cerebral Palsy; CT: Control