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CASE STUDY

Global postural re-education for an adult with cerebral palsy: case study

Reeducação postural global em um adulto com paralisia cerebral: um estudo de caso

La reeducación postural global en un adulto con parálisis cerebral: estudio de caso

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ABSTRACT | The effects of an intervention program with global postural reeducation (GPR) and a period of no treatment (8 weeks) were evaluated by kinematic analysis and evaluation of static and dynamic balance of an adult with cerebral palsy (CP). Evaluations of balance were made using the Berg Balance Scale, as well as gait kinematics evaluations, in which spatiotemporal and angular variables were analyzed. These assessments were made at the beginning and at the end of each intervention period. To characterize the parameters examined, descriptive statistics (mean and standard deviation) was used. The studied subject showed improvement of balance after the intervention period and, regarding angular variables, decreased hip extension and less trunk tilt were found. With the improvement of balance, hip extension and alignment of the trunk of the treated patient, it is suggested that the GPR intervention method can be effective as a practice of physical therapy for CP; however, more effective results may be associated with continuous treatment with this method, since during the intervals of the intervention, there was a reduction in balance.

Keywords | Gait; Postural Balance; Cerebral Palsy.

RESUMO | Foram avaliados os efeitos de um programa de intervenção com reeducação postural global (RPG) e um período sem tratamento (8 semanas) pela análise cinemática e avaliação do equilíbrio estático e dinâmico de um adulto com Paralisia Cerebral (PC). Foram realizadas avaliações do equilíbrio por meio da Escala de Equilíbrio de Berg e avaliações cinemáticas da marcha, nas quais foram analisadas variáveis espaçotemporais e angulares. Essas avaliações foram feitas no início e no final de cada período de intervenção. Para a caracterização dos parâmetros analisados foi utilizada a estatística descritiva (média e desvio padrão). O sujeito estudado apresentou melhora do equilíbrio após o período de intervenção e, em relação às variáveis angulares, foi verificada diminuição da extensão de quadril e menor inclinação de tronco. Com a melhora do equilíbrio, da extensão do quadril e do alinhamento do tronco do paciente tratado, sugere-se que a intervenção com o método RPG pode ser eficaz como conduta fisioterapêutica para a PC, porém resultados mais eficazes podem estar associados com o tratamento contínuo por esse método, uma vez que durante os intervalos da intervenção, observou-se diminuição do equilíbrio.

Descritores | Marcha; Equilíbrio Postural; Paralisia Cerebral.

RESUMEN | Se han evaluados los efectos de un programa de intervención con reeducación postural global (RPG) y un periodo sin tratamiento (8 semanas) por el análisis cinemático y evaluación del equilibrio estático y dinámico de un adulto con Parálisis Cerebral (PC). Se han realizado evaluaciones de equilibrio a través de Escala de Equilibrio de Berg y evaluaciones cinemáticas del paso, en las cuales se han analizadas las variables

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espacio-temporales y angulares. Estas evaluaciones se han hecho al inicio y al final de cada periodo de intervención. Para caracterizar los parámetros analizados se utilizó la estadística descriptiva (media y desvío medio). El sujeto estudiado presentó una mejora del equilibrio tras el periodo de intervención y, respecto a las variables angulares, se han verificado una disminución de la extensión de la cadera y menor inclinación del tronco. Debido a la mejoría del equilibrio, de la extensión de la cadera y del alineamiento del tronco del paciente, se propone que la intervención con el método RPG puede ser eficaz como una conducta fisioterapéutica a la PC; no obstante, los resultados más eficaces pueden asociarse al tratamiento seguido al utilizar este método, puesto que durante los intervalos de la intervención, se ha observado una disminución del equilibrio.

Palabras clave | Marcha; Equilibrio Postural; Parálisis Cerebral.

INTRODUCTION

The permanent disorders in posture development and movement experienced by patients suffering from Cerebral Palsy (CP) are factors that cause limitations in functional activities[1]. Along with the trend of the increasing life expectancy of these patients[2], their functional incapacity becomes a matter for greater concern. Losses of functionality in patients may be related to decreased flexibility, strength and endurance, and increased spasticity, fatigue, pain and musculoskeletal changes[3,4], which leads to limitations in gait function. Several compensatory strategies are used as a result[5].

The main changes in the gait of adults with CP happens through the position of the foot in equinus, knee flexion, shortening of the lower limbs[6] and muscle weakness[7]; as a result, these individuals have lower spatiotemporal variables when compared to healthy adults[8]. In addition, an individual with CP presents static and dynamic balance deficits, which are further worsened with musculoskeletal and sensory changes[9].

Intervention programs geared towards these individuals are intended to prevent musculoskeletal alterations and improve postural control, thus allowing stability to be effectively regained[10]. Global postural re-education (GPR®) is used to prevent and treat musculoskeletal changes. Global stretching postures associated with respiration and proprioceptive stimuli[11] are designed to balance myofascial tension and posture as a whole[12]. Positioning the joints correctly and strengthening muscles through GPR[13] can be an alternative method for physiotherapists to utilize while treating these patients.

Despite the fact that GPR is widely used in clinical practice, there are not a great deal of studies that prove its effectiveness[11]. This method has been used to treat urinary incontinence[14], thoracic kyphosis[15], fibromyalgia[16], scoliosis[17], temporomandibular dysfunction[11], cerebrovascular accident (CVA)[18] and cardiovascular diseases[19], however, no study in the reviewed literature was found regarding the use of this technique with CP patients. Based on the particularities of individuals with CP as well as the benefits that can be achieved through GPR, it is considered that this method can be an effective treatment for musculoskeletal changes in these patients and provide changes in their gait parameters. In respect of the aforementioned, this study's objectives were to evaluate the effects of a GPR intervention program and a period without treatment (8 weeks) by kinematic analysis and evaluation of static and dynamic balance of an adult with CP.

METODOLOGY

This case study was performed at the School Clinic of Physiotherapy at the Center for Health Sciences and Sports (CEFID) at the State University of Santa Catarina from September, 2011 to May, 2012. The school's responsible representative was made aware of all the procedures that would be performed and their objectives. After this clarification was completed, both a Term of Free and Informed Consent (TFIC) and a term of consent to use photographs, videos and recordings were signed. The research was approved by the Ethics Committee on Human Research (ECHR) at the State University of Santa Catarina (protocol no. 154/201).

The research subject was a 26 year old adult female with spastic diparetic cerebral palsy. The causes for this CP were hypoxemia and cerebral ischemia during the neonatal period. Since the patient was eleven years old she has undergone conventional physiotherapy, without doing any kind of physical activity. The patient presents vision and speech changes, has the functional ability to

feed herself, dress herself and perform her own personal hygiene as well as participate in the formal labor market.

The inclusion criteria were: to have been definitively diagnosed with diparetic-type CP, to be able to understand simple verbal commands and to perform independent gait. Exclusion criteria were: to have fixed deformities on the hip, knee and ankle and to have applied botulinum toxin or had correction surgery less than six months before the selection.

An identification form and anamnesis were used so as to obtain and record the data. Body mass was measured using a Filizola digital scale, precise to 0.1kg. Height was determined using a stadiometer, precise to 1mm.

The intervention was performed using the GPR method over two periods. The first period lasted 10 consecutive weeks, with one hour long session being performed per week. Following this, there was an 8-week interval. The second intervention period began after the completion of the interval, consisting of 10 more sessions. Among the GPR techniques used were the following postures: "frog on the ground with arms closed" and "standing upright with anterior tilt" or "dancer". At the beginning of each session preparatory maneuvers were performed with included cervical stretching, pompage, cervical traction, and lumbar traction.

This stretching method has a long duration (approximately 15 minutes) for each specific posture, in which one muscle group is stretched. The posture is chosen according to the needs of the patient, causing it to decrease the compensation in close and distant muscle groups[20].

During the "frog on the ground with arms closed" posture, the patient remains for 15 minutes in the supine position, arms extended along the body in supination, with hip and knee flexion, dorsiflexion, while keeping the heels up against each other. This approach aims to strengthen the abdominal muscles through isometrics that result from lower limb support, along with elongating the paravertebral and opening the intervertebral spaces by pelvic retroversion[21]. The patient must have his knees extended and aligned at the end of the posture[13.] The patient was asked to inhale slowly with prolonged expirations, thereby lowering the ribs as much as possible in order to stretch the respiratory chain[22]. The "dancer" posture is performed with the patient standing, with the forearms supported on the bed, with trunk flexion, thereby stretching the posterior chain[13.]

The evaluations were performed at the beginning and end of each intervention period using the GPR method (Figure 1). The intervention and the evaluations were conducted by the same assessor.

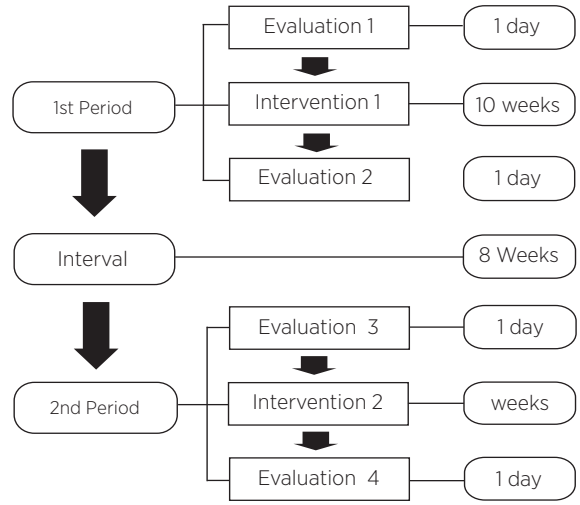

Figure 1. Flowchart of the evaluation and intervention procedures

With the objective of analyzing gait and balance, gait kinematics and balance assessment were performed by the Berg Balance Scale (BBS) at the beginning and end of each intervention period with the RPG method, totaling 4 evaluations (Figure 1).

In order to obtain the kinematic data, the individual was instructed to remain barefoot and wear a bathing suit so that visualizing the anatomical points was better. Reflective spherical markers with a 1cm diameter were fixed on the right hemicorpo, the side with the greater impairment, and at the following anatomical points: acromion of scapula; greater trochanter of the femur; lateral epicondyle of the femur; lateral malleolus of the tibia and fifth metatarsophalangeal joint. The patient was then positioned on the walkway and asked to walk at a comfortable speed, with her arms hanging loosely down the body, for 6m. The filming was performed on the right sagittal plane, using a CASIO Exilim EXFH20 digital camera fixed on a 73cm tall tripod placed perpendicularly 3.5m from the wall, with the center of the camera lens 75cm from the ground. The system was calibrated with four dots forming a square on the wall, with a distance of 1m between one and another, and a fixed point placed on the floor. Video editing and digitalization was performed using Ariel Performance Analysis System (APAS) 1.4. The

analyzed angles can be seen in Figure 2 and correspond to one stride.

The analyzed spatiotemporal variables were: stride time, stride length, stride speed and support time. A stride was defined as being the first contact made by right heel on the ground until a second contact is made by the same foot[23]. The support time was defined as the time the right foot was in contact with the ground, making up 60% of the entire gait cycle[23].

The analyzed angular variables were: hip (flexion at initial contact, flexion peak during the swing, extension peak during the swing, total extension peak), knee (flexion at initial contact, extension peak in the support and flexion peak during the swing) and inclination of the torso (mean of the cycle). The values for the flexion and extension of the hip and knee, and inclination of the torso are shown in Figure 2, where the peak value represents the mean of the highest values found during each assessment. Initial contact (10% of the whole cycle) was defined as the right heel's first contact on the ground, the swing phase being when the entire right foot was not in contact with the floor, accounting for 40% of the gait cycle, and the support phase, representing 60% of the entire cycle, being when any part of the right foot was in contact with the ground[23].

During the balance assessment the BBS was used, it was altered to the Portuguese language with maximum score of 56 points[24]. Instructions to begin an activity were given orally for each one.

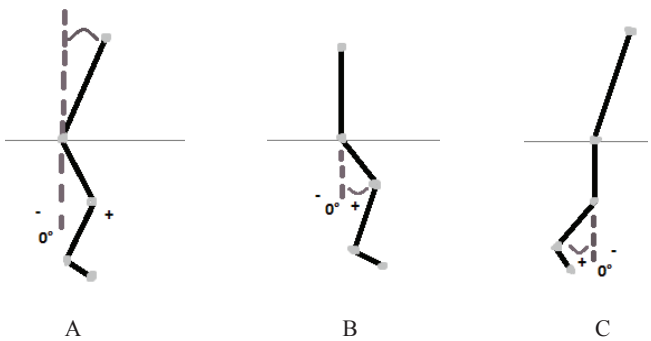

Figure 2. Demonstration of the tilt angle analysis of the trunk (A), hip (B) and knee (C), in which positive values signify flexion and the negative values signify extension

In order to characterize the analyzed parameters, descriptive statistics (mean and standard deviation) were used. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) software, version 20.0.

RESULTS

The evaluated subject was an 1.48m tall adult with CP. Body mass and the Body Mass Index (BMI) were measured during each evaluation, with the following results: Evaluation 1:61kg–BMI 27.85kg/m^2; Evaluation 2: 60.4kg–BMI 27.57kg/m^2; Evaluation 3:61.3kg–BMI 27.98kg/m^2; Evaluation 4: 62.4kg–BMI 28.48kg/m^2. According to the World Health Organization, these BMI values are above what is ideal (18.5 to 24.9kg/m^2).

Regarding balance, the evaluated subject achieved a score of 48 during the BBS before the first intervention period, and a score of 50 after its completion. During the second intervention period, the subject with CP recorded a score of 48 score before and 51 after.

The results from the spatiotemporal and angular variables of the gait during the four evaluations are presented in Tables 1 and 2, respectively.

Table 1. Mean and standard deviation (SD) of the angular variables obtained during the four kinematic gait evaluations, on the sagittal plane, in an adult with cerebral palsy

Variables	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Stride time (s)	0.91 (0.05)	0.94 (0.06)	0.92 (0.00)	0.91 (0.04)
Stride length (m)	1.19 (0.05)	1.20 (0.08)	1.21 (0.12)	1.15 (0.03)
Stide speed (m/s)	1.31 (0.11)	1.28 (0.15)	1.32 (0.13)	1.26 (0.06)
Support time (% cycle)	68.49 (4.93)	77.28 (7.48)	77.28 (7.48)	69.33 (2.36)

DISCUSSION

This study aimed to assess the effects of intervention with GRP on the gait and balance of an adult with spastic diparetic CP. The chosen stretching postures from the GRP method were "frog on the ground with arms closed" and "dancer".

The difficulty that CP patients have to stretch their spastic muscles means that certain muscle groups become shortened, which results in balance problems[25]. The results from the BBS evaluation demonstrated that interventions using GPR may have contributed to the increase in balance. Whereas, following the interval, there was no decrease in this score, which may indicate that there were muscle shortenings and changes

Table 2. Mean and standard deviation (SD) of the angular variables obtained during the four kinematic gait evaluations, on the sagittal plane, in an adult with cerebral palsy

Variables	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Hip				
Flexion at initial contact	39.35 (3.42)	38.19 (2.50)	29.16 (2.57)	22.14 (4.20)
Flexion peak during swing	38.65 (3.03)	38.91 (1.31)	23.71 (2.24)	23.62 (2.77)
Extension peak during swing	17.73 (5.81)	21.35 (3.17)	1.88 (1.51)	0.52 (3.74)
Total extension peak	4.98 (3.76)	11.41 (3.13)	-8.48 (1.63)*	-5.81 (2.71)*
Knee				
Flexion at initial contact	32.95 (3.77)	28.66 (1.91)	25.81 (2.59)	30.17 (2.89)
Extension peak during support	8.95 (5.05)	14.94 (2.10)	10.01 (2.27)	12.81 (3.27)
Flexion peak during swing	80.29 (3.15)	72.27 (3.75)	67.96 (2.41)	75.31 (4.80)
Torso inclination				
Mean of the cycle	8.25 (1.18)	9.63 (1.28)	0.89 (0.36)	0.37 (1.03)

* The negative value refers to a hip hyperextension

in postural balance. Thus, long periods with no global stretches should be avoided in CP patients.

Similarly, it is difficult for CP patients to maintain balance in static situations, these patients present dynamic motion control impairment[26], as is the case during their gait. While comparing spatiotemporal and angular parameters of gait in healthy individuals in the literature[8,27], it was observed that the results found in this study are different.

Patients with CP tend to have smaller spatiotemporal variables when compared with healthy adults[8]. Generally, stride length in the adult population is approximately 1.41m, with stride speed being 1.35m/s[27]. this study found an mean of 1.19m and 1.29m/s, respectively. In a study that showed gait training with different forms of support in a child with CP, with the support of shoulder belt, the child demonstrated a stride length of 68cm and speed of 36m/s[28]. Stride length is directly proportional to age[29]. Any decrease in these parameters in patients with CP is influenced by movement control disorders[30] and functional impairment[31]. These changes in the spatiotemporal variables may be connected with achieving a more stable and secure stride. However, the increase in the balance which was verified during the study period, i.e. during the two intervention periods, did not influence these variables.

According to the angular variables when compared with the first and fourth evaluation, there was an observed increase in hip extension as well as in torso correction. The knee variables showed no difference during the analyzed period. Healthy adults have a peak knee extension during mid stance with an 8.66 angle (5.42)[32] and a mean knee flexion at the initial contact of 3.17 (4.86)[33]. When the values from these parameters are taken into account, it is possible to see that the patient under study did not have any knee deformities and/or major limitations. The degree of pelvis and torso flexion is proportional to the gait speed[34]. This study showed that the variation in stride speed was small, but there was no difference in the alignment of the torso during the evaluations. The belief is that excessive torso flexion in spastic diparetic CP is associated with general muscle weakness, which alters the balance of the muscles that perform hip rotation[35]. In the gait of children with CP, the pelvis and torso can be used to offset deficiencies in the lower limbs[36]. Following the first evaluation, there was no observed improvement in torso inclination; however, between the first and fourth evaluation (8.25 and 0.37 degrees) there was an increase in torso correction. Torso correction may have been improved by means of torso stretching and strengthening, which is required during the GPR postures that are used in the intervention periods. In addition to the decreased torso inclination, the reduced hip angular extension, i.e., greater degrees of freedom of this during the gait cycle, indicated a quantitative and qualitative gain in gait performance. These results are of importance for clinical practice, because at present it is very difficult for patients with CP to have adequate hip extension. This difference may have been obtained as a result of the stretching undertaken during the proposed activities.

Balanced muscle tension in each isolated muscle is important to ensure that every muscle group performs well, and in regards to movement it is necessary to

balance static and dynamic muscles[37]. This study only used two postures during the interventions, without moving to any exercises. Due to the fact that CP is characterized by posture and movement disorders, it must be stressed that intensifying and diversifying patient stretching exercises is necessary.

There was a belief that the patient evaluated in this study would show effective results after treatment with GPR, as well as keep such improvements after the completion of the intervention. In view of the fact that there was improvement in the patient's balance during this study, it is suggested that more work is performed on patients with CP who have been treated using the GPR method.

CONCLUSION

With the improvement in the treated patient's balance, hip extension and torso alignment, it is suggested that intervention with the GPR method can be effective as a physiotherapeutic approach for CP, however, the most effective results are more likely to be achieved with continuous treatment with this method, since there was an observed decrease in balance during the interval between the intervention. The intention behind performing this study was to contribute to future research on this applied method for treating patients with CP.

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