41 - THE EFFECTS OF FUNCTIONAL ELECTRICAL STIMULATION IN MARCH OF CHILDREN WITH HEMIPARETIC CEREBRAL PALSY

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SUMMARY:

Introduction: Cerebral Palsy (CP) will interfere with the movements due to abnormal patterns of coordination, posture and muscle tone. The hemiparetic gait does not have the touch of the calcaneus at the beginning of bipedal support by the inability of the anterior tibial muscle to produce enough voltage to make the movement of dorsiflexion. . The phase jump is also compromised due to the weakness of the triceps surae, constituting a limiting factor for the march. Morphological studies suggest that the weakness of the paretic muscle is more disabling than spasticity. The Functional Electrical Stimulation (FES) promotes building with the possibility of reduction of cortical asymmetry, it involves processes related to voluntary movement. Objective: The objective of this study is to compare the effects of FES on gait function in patients with PC after its implementation in the tibialis anterior and triceps surae. Materials and methods: The research is the original type design with a case study. The participants were two patients of both genders, with three years of age, intentionally selected, with the clinical diagnosis of PC and independent walking hemiparetic. Results: The results obtained by the GMFM scale, found further progress in the patient who received the FES in the triceps surae, as well as improvement in passive MA and increased muscle strength and dorsiflexors plantiflexores, reducing the degree of spasticity and changes in the variables of march. Conclusion: Thus the FES has shown positive results in the treatment of spastic muscles with changes in the functionality of the march.

INTRODUCTION

Cerebral Palsy (CP) Chronic encephalopathy or non-progressive for Children is a non-progressive disease of multiple etiologies, resulting in damage to the central nervous system in early stages of brain development. It is one of the most important neurological diseases such interferes with the performance of movements as a result of abnormal patterns of coordination, posture and muscle tone, impeding or preventing the acquisition of motor skills and cognitivas (MARANHÃO, 2005; VIVON et al., 2007).

Its incidence in developed countries is 2:1000 births in developing countries is 7:1000 births. In Brazil, data estimate about 17 thousand new cases per year and is considered a social problem and health pública (ROTTA et al.,2002; MANCICNI et al., 2002)..

Can be classified as spastic, athetoid, ataxic, hypotonic or mixed. Since the spastic form is the most common and can be classified according to the topography in quadriplegia / quadriparesis, diplegia / or diparetic hemiplegia/hemiparesia2. The hemiparesis is characterized by motor deficit with unilateral spasticity, affecting the paralyzed contralateral cerebral hemisphere afetado (JERÔNIMO et al., 2007).

Spasticity is the result of disturbances of proprioceptive spinal reflexes, manifested clinically by abrupt movement of the tendon hyperreflexia to passive movement and muscle co-contraction of agonist-antagonist. The adaptations are secondary to spasticity, weakness and muscle atrophy, changes in connective tissues and decreased quality of motor function, producing considerable disability of activities of daily living (GUIMARÃES et al., 2007)..

The start hemiparetic gait presents extension of the lower limb and foot in equinovarus paralyzed affected, therefore there is on your heel at the beginning of bipedal support by the inability of the anterior tibial muscle to produce enough voltage to make the movement of dorsiflexion. The phase jump is also compromised due to the weakness of the triceps surae, the most important muscle in the implementation of plantar flexion. This factor is limiting for the transfer from sitting to standing, to remain in the standing position and start (GUIMARÃES et al., 2007).

Some morphological studies of the paretic muscles suggests that muscle weakness is more disabling than the spasticity, this occurs as a result of disuse, loss of trophic effects central neurogenic atrophy, loss of motor units and changing the order of recruitment. Thus the strengthening is needed to improve the efficiency, capacity of power generation and the ability motora (ROTTA et al., 2002; GUIMARÃES et al., 2007).

The increase in strength by strengthening program in paretic limbs is associated with improved speed and cadence of gait, functional tasks such as walking, sitting, standing, climbing and descending stairs, as well as increased balance during the support but without increasing spasticity (GUIMARÃES et al., 2007).

The Functional Electrical Stimulation (FES) is a muscle-building technique that promotes contraction of muscles deprived of nervous control, with the main goal of increasing muscle strength, reduce spasticity, improve motion's amplitude (MA), activate the reflexes needed to reorganization of motor activity and allow a reduction of cortical asymmetry, because the sensorimotor processing during FES involves processes related to movement voluntary (ARANTES et al., 2007; ECARD et al., 2007).

In our data set is worth asking what the benefits of the functionality of FES gait in children with cerebral palsy after its implementation in the tibialis anterior and triceps surae.

Studies have shown the benefits of a strengthening program on muscle spasticity in stroke patients, however, was not found in the literature this approach in patients with CP. Studies have shown that besides reducing muscle weakness strengthening also increases the range of motion and reduces the values of spasticity. These changes act directly on the functionality to improve the gait pattern allowing the acquisition of skills daily (ECARD et al., 2007).

This study is relevant to the recognition of electrical stimulation as a treatment for PC. In addition to demonstrating the effects of this, when applied to the tibialis anterior and triceps surae. This new treatment approach would be valid for the students of Physical Therapy as well as for professionals, because this has positive effects on the treatment of spasticity. The CP patients would benefit from its results allowing a better acquisition of daily activities.

Thus, the general aim of this study is to compare the effects of FES on gait function in patients with CP after its implementation in the tibialis anterior and triceps surae. The specific objectives are to increase muscle strength, increase range of motion, reduce the degree of spasticity, increase speed and rhythm of movement, enabling a better functionality of the gait of

these patients.

MATERIALS AND METHODS

This research is the original type design with a case study conducted at the Association of Parents and Friends of Exceptional Circumstances (APAE) in Ubá (MG).

Sample

Participants were two patients of both genders, with three years of age, intentionally selected, with the clinical diagnosis of PC hemiparetic and independent walking.

Instruments

Were measured motion's amplitude (MA) of dorsiflexion and plantarflexion of the ankle paretic limb in the supine position with the universal goniometer CARCI, moving up and passive (VENTURIN, 2006).

The manual test of muscle strength was applied to the tibialis anterior and triceps surae. His undergraduate degree is the ability to keep the part tested in a position against gravity can be classified as: 0 - absence of muscle contraction, 1 - muscle contraction without joint movement, 2 - movement without joint action of gravity, 3 - movement against gravity; 4 - movement against a small resistance, 5 - movement against big resistance (JUNQUEIRA et al., 2004).

The degree of spasticity of the triceps surae was measured by the Modified Ashworth Scale, where the ankle was moved into dorsiflexion passive quickly and brusca (SCHUSTE et al., 2007).

For gait analysis parameters were evaluated: speed, cadence, stride length, and width of the last base of support, through the Protocol of Cerny. The instruments were: timer mark Herweg, a walkway 16 meters arranged in the initial 5 meters, 6 meters and 5 meters power users. The five meters opening and closing were not considered because they represent periods of acceleration and deceleration of movement. The stopwatch was started when the patient entered the central area, the count was stopped when it reached the end of the central area (JERÔNIMO et al., 2007).

The calculations were extracted from these records. To mark the runway in step length was necessary to use ground coffee in the face plant. The placement of the feet on the ground was so free and spontaneous, and walk as soon as possible. By convention, the patients received the bare. To calculate the stride length and stride was calculated the average of three random measures. The speed calculation was performed using the formula: $\Delta V = \Delta S / \Delta t6$. Cadence was calculated by counting the number of steps by a minuto5. To record the images of walking before and after the intervention was used Camcorder JVC brand, with the permission of parents or guardians.

The children were subjected to functional analysis using the test Gross Motor Function Measure (GMFM) to quantify motor performance. This test includes 5 dimensions, but were analyzed only dimensions: 4 - feet, and 5 - walking, running and jumping, to make research more objective. Each item was measured by observing the patients and categorized into an ordinal scale of 4 points where 0 = does not, 1 = start (<10%), 2 = partially complete (10 to <100%), 3 = track activity (CALCÁGNO et al., 2006).

Procedure

Evaluations using the tools mentioned above were taken before and after physical therapy intervention. Was drawn to the local stimulation. In patient 1, the electrodes of rubber, size 5x5 cm (cm) were placed in a motor point of tibialis anterior and 2 cm below. During the passage of current was asked to move to climb stairs (15 cm). In patient 2, the electrodes were positioned on the motor point of the triceps surae and the other 2 cm below the passage of the current realization of the movement of stairs (15 cm) (JERÔNIMO et al., 2007).

We used the apparatus Physiotonus Four brand ® Cap, applying neuromuscular electrical currents through the low-frequency current FES biphasic, with parameters fixed at 250 ms modulated at 50 Hz, Ton 06 sec, 12 sec Toff, and intensity as the tolerance of the patient. Sessions were held for 20 minutes three times a week every other day for seven weeks, totaling 21 sessions. During the research patients were not undergoing therapy convencional (SCHUSTE et al., 2007).

The research project was referred to the Committee on Ethics in Research of Unipac obeying the resolution of the National Health Council (CNS) 196/96.

Statistical analysis

Was performed a descriptive analysis of strength and muscle tone, MA and the score of GMFM scale.

RESULTS AND DISCUSSION

After the stimulation was observed improvement in functional activity of gait measured by dimensions D (standing) and E (walking, running, jumping) of GMFM scale, the two children, but it was higher than that received in the triceps muscle electrostimulation sural (Table 1 and 2).

Table 1: Presentation of the results of the GMFM scale in patient 1 (tibialis anterior).

GMFM (Patient 1)	Pre-electro	Post-electro	Evolution
Dimension R (39)	21	36	15
Dimension L (72)	42	55	13

Table 2: Presentation of the results of the GMFM scale in patient 2 (triceps surae).

GMFM (Patient 1)	Pre-electro	Post-electro	Evolution
Dimension R (39)	16	34	18
Dimension L (72)	29	45	16

The study by Drouin et al. concluded that the dimensions D and E of the GMFM can be used as prognostic locomotive. Complementing this study, DAMIANO et al investigated the correlation between the GMFM and gait parameters in children with

spastic CP, and confirmed that walking is representative of motor status in the global PC, and the GMFM and gait analysis are complementary measures in functional assessment of these children.

We observed improvement in active Movement's Amplitude (MA) of the Pac 1 plantarflexion 10°, 2 of the Pac 25, remained the measures of active dorsiflexion in both patients. The evolution of passive ROM was higher in the Pac 2, about 10 º of plantarflexion and 20 ° of dorsiflexion. The Pac 1 Total 10 degrees over the Movement's Amplitude (MA) passive plantarflexion and dorsiflexion was maintained (Table 3 and 4).

Table 3: Results obtained from active Movement's Amplitude (before and after treatment).

MA active	Pat 1	Pat 2
Plantarflexion	>10°	>25°
Dorsiflexion	____	___

Table 4: Results obtained from passive Movement's Amplitude before and after treatment.

MA passive	Pat 1	Pat 2
Plantarflexion	>10°	>10°
Dorsiflexion	___	>20°

ARANTES et al concluded through a review of the literature that there are significant gains after electrostimulation of MA. Already MARTINS et al were able to conclude that the FES is an important therapeutic adjunct resource for obtaining drive both active and passive.

With regard to muscle tone, there was a reduction of the Ashworth scale in patients 2 and maintenance of the level in patient 1 (Table 5).

Table 5: Assessment of muscle tone of triceps surae of patients before and after stimulation

Ashworth Scale	Pre	Post
Pat 1	1+:Slight increase in tone in the middle of remaining MA	1+:Slight increase in tone in the middle of remaining MA
Pat 2	1+:Slight increase in tone in the middle of remaining MA	1:Slight increase in tone at the end of MA

HAMILL et al argue that the shortened muscle is unable to generate much tension because its contractile protein filaments are overlapped creating an incomplete activation of cross bridges. Thus, the reduction of cross-bridge develops a weak muscle and inadequate to generate large amounts of force. Thus, the weakness reflects the inability to generate force by decreasing the activation of motor units or the physiological changes of muscle parético (HAMILL & KNUTZEN, 1999).

Another important finding of this study was that the degree of muscle strength plantiflexores of patient 1 decreased, while that of patient 2 increased. The strength of dorsiflexors is maintained in patient 1, and increased in patient 2.

Corroborating the results obtained, Guimaraes et al also found in their study a significant improvement in muscle strength after eletroestimulação (GUIMARÃES et al., 2007).

JUNQUEIRA states that techniques and muscle strengthening exercises work by increasing the recruitment of motor units, improving the capacity of power generation, reducing the hyperarousal reflex and preserving functional extensibility muscle (JUNQUEIRA et al., 2004).

The variables of gait assessed by protocol Cerny showed improvements in two patients. For healthy children aged 4 years of age, the average values for the length of the last cadence and speed are 0.78 cm, 152 steps / min and 0.99 m / sec, respectively. JERÔNIMO et al showed increased speed and reduction in the rate after application of SSF in tibialis anterior (JERÔNIMO et al., 2007).

SHUSTER et al, claim that these results are only obtained because the electrical stimulation promotes cutaneous feedback and proprioception, improving balance and favoring march (SCHUSTER et al., 2007).

Damázio et al reported that the performance of the protocol Cerny may be due to improvement of MA, activation of motor endplates by FES and reducing the tone muscular(DAMÁZIO et al., 2007).

Thus, the FES has been shown to be a reliable protocol because it promotes neuronal recruitment in selected areas, the same amount in each cerebral hemisphere asymmetry reducing cortical (BRASILEIRO & SALVINI, 2004; KITCHEN & BAZIN, 1998).

CONCLUSION

The results found more satisfactory effects in children with CP referred to the FES in triceps surae, as increased muscle strength, gait patterns have evolved, decreased muscle tone, range of motion of plantarflexion and dorsiflexion movements in assets and liabilities, after 21 sessions. Contrary to what is often used to treat patients with spasticity, the strengthening of the spastic muscle showed positive results. Thus it is recommended to select a random sample with a larger population of patients with PC type hemiparetic spastic, and the realization of a control group to determine with greater accuracy the benefits of FES.

KEYWORDS: CEREBRAL PALSY, FUNCTIONAL ELECTRICAL STIMULATION.

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THE EFFECTS OF FUNCTIONAL ELECTRICAL STIMULATION (FES) IN THE GAIT OF CHILDREN WITH HEMIPARETIC CEREBRAL PALSY (CP)

SUMMARY

The Cerebral Palsy (CP) acts in the implementation of the movements due to abnormal patterns of coordination, posture and muscle tone. The hemiparetic gait does not show the touch of the calcaneus at the beginning of the bipedal support because the previous tibial muscle does not produce enough strength to perform the movement of dorsiflexion. The stage of the push is also compromised as a result of the weakness of the surae triceps muscle, constituting limiting factor for gait. Morphological studies suggest that the weakness of the paretic muscle is more disabling than the spasticity. The Functional Electrical Stimulation (FES) promotes the strengthening with the possibility of reducing the cortical asymmetry, as it involves processes related to voluntary movement. This present work have as objective to compare the effects of FES in the functionality of gait in patients with CP after its implementation in the previous tibial and triceps surae muscles. The results obtained by the GMFM score showed greater progress in the patient who received the FES in the surae triceps muscle, as well as improvement of the passive ADM and increase of muscular strength in dorsiflexors and plantiflexors, reducing the degree of spasticity and changes in the variables of the gait. The FES showed positive results in treating spastic muscles with developments in the functionality of the gait.

WORD-KEY: Cerebral Palsy. Functional Electrical Stimulation.

LÊS EFFETS DE STIMULATION ELECTRIQUE FONVTIONNELLE DE MARS DÊS ENFANTS AVE HEMIPARÉSIE PARALYSIE CÉRÉBRALE

RÉSUMÉ

Introduction: la paralysie cérébrale (PC) interfèrent avec les mouvements en raison des tendances anormales de la coordination, la posture et le tonus musculaire. L'allure hémiparésie n'a pas le contact du calcanéum au début du soutien bipède par l'incapacité du muscle tibial antérieur à produire suffisamment de tension pour faire le mouvement de flexion dorsale. . Le saut de phase est également compromise en raison de la faiblesse du triceps sural, ce qui constitue un facteur limitant pour le mois de mars. Études morphologiques suggèrent que la faiblesse du muscle parétique est plus invalidante que la spasticité. La stimulation électrique fonctionnelle (FES) favorise le renforcement, avec la possibilité de la réduction de l'asymétrie corticale, il s'agit de processus liés au mouvement volontaire. Objectif: L'objectif de cette étude est de comparer les effets de la FES sur la fonction et la marche chez les patients avec PC après sa mise en œuvre dans le muscle tibial antérieur et du triceps sural. Matériel et méthodes: La recherche est la conception de type originale avec une étude de cas. Les participants étaient deux patients des deux sexes, avec trois ans d'âge, intentionnellement sélectionné, avec le diagnostic clinique de PC et indépendante hémiparésie marche. Résultats: Les résultats obtenus par l'échelle GMFM, a trouvé de nouveaux progrès dans le patient qui a reçu la SEF dans le triceps sural, ainsi que l'amélioration dans la ROM passive et la force musculaire accrue et plantiflexores dorsiflexors, en réduisant le degré de spasticité et les changements dans les variables de mars. Conclusion: Ainsi, le FES a montré des résultats positifs dans le traitement des muscles spastiques à des changements dans la fonctionnalité du mois de mars.

MOTS-CLÉS: paralysie cérébrale, la stimulation électrique fonctionnelle.

LOS EFECTOS DE ESTIMULACIÓN ELÉCTRICA FUNCIONAL EM MARZO DE NIÑOS COM PARÁLISIS CEREBRAL HEMIPARÉTICA

RESUMEN

Introducción: La parálisis cerebral (PC) interfiere con los movimientos, debido a patrones anormales de la coordinación, la postura y el tono muscular. La marcha hemiparética no tiene el toque del calcáneo en el principio de apoyo bípedo por la incapacidad del músculo tibial anterior para producir voltaje suficiente para hacer el movimiento de la flexión dorsal. El salto de fase también se ve comprometida debido a la debilidad del tríceps sural, que constituyen un factor limitante para la marcha. Los estudios morfológicos sugieren que la debilidad del músculo parético es más incapacitante que la espasticidad. La estimulación eléctrica funcional (FES) promueve la construcción con la posibilidad de la reducción de la asimetría cortical, se trata de procesos relacionados con el movimiento voluntario. Objetivo: El objetivo de este estudio es comparar los efectos de la FES sobre la función de la marcha en los pacientes con PC después de su aplicación en el tibial anterior y tríceps sural. Materiales y métodos: La investigación es el diseño de tipo original con un estudio de caso. Los participantes fueron dos pacientes de ambos sexos, con tres años de edad, seleccionada intencionalmente con el diagnóstico clínico de PC y hemiparética independente marcha. Resultados: Los resultados obtenidos por la escala GMFM, que se encuentra avanzando en el paciente que recibió el músculo FES tríceps sural, así como la mejora de la movilidad pasiva y la fuerza muscular y aumento de dorsiflexores plantiflexores, reduciendo el grado de la espasticidad y los cambios en las variables de la marcha. Conclusión: Los resultados positivos tanto, la FES ha demostrado en el tratamiento de los músculos espásticos con los cambios en la funcionalidad de la marcha.

PALABRAS CLAVE: parálisis cerebral, la estimulación eléctrica funcional.

OS EFEITOS DA ESTIMULAÇÃO ELÉTRICA FUNCIONAL NA MARCHA DE CRIANÇAS COM PARALISIA CEREBRAL HEMIPARÉTICA

RESUMO

Introdução: A Paralisia Cerebral (PC) interfere na execução dos movimentos devido aos padrões anormais da coordenação, postura e tônus muscular. A marcha hemiparética não apresenta o toque do calcâneo no início do apoio bipodal pela incapacidade do músculo tibial anterior em produzir tensão suficiente para realizar o movimento de dorsiflexão. A fase de impulsão também fica comprometida em decorrência da fraqueza do músculo tríceps sural, constituindo fator limitante para a marcha. Estudos morfológicos sugerem que a fraqueza do músculo parético é mais incapacitante que a espasticidade. A Estimulação Elétrica Funcional (FES) promove fortalecimento com possibilidade de redução da assimetria cortical, pois envolve processos relacionados à movimentação voluntária. Objetivo: O objetivo do presente estudo é comparar os efeitos da FES na funcionalidade da marcha em pacientes com PC após sua aplicação nos músculos tibial anterior e tríceps sural. Materiais e métodos: A pesquisa é do tipo original com delineamento de estudo de caso. Participaram da pesquisa dois pacientes de ambos os gêneros, com três anos de idade, selecionados intencionalmente, com o diagnóstico clínico de PC hemiparética e marcha independente. Resultados: Os resultados obtidos pela escala GMFM, constataram maior evolução no paciente que recebeu a FES no músculo tríceps sural, assim como melhora da ADM passiva e aumento de força muscular de dorsiflexores e plantiflexores, redução do grau de espasticidade e evolução nas variáveis da marcha. Conclusão: Desta forma a FES demonstrou resultados positivos no tratamento de musculatura espástica com evolução na funcionalidade da marcha.

PALAVRAS-CHAVE: Paralisia Cerebral, Estimulação Elétrica Funcional.

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