Research in Developmental Disabilities 35 (2014) 2547–2557

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Facilitation handlings induce increase in electromyographic activity of muscles involved in head control of Cerebral Palsy children

Anelise de Saldanha Simon [a], Alexandre Severo do Pinho [b], Camila Grazziotin dos Santos [c], Aline de Souza Pagnussat [a,b,d,*]

[a] Programa de Pós-graduação em Ciências da Reabilitação, Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA), Brazil
[b] Departamento de Fisioterapia, Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA), Brazil
[c] Programa de Pós Graduação em Saúde da Criança e do Adolescente, Universidade Federal do Rio Grande do Sul (UFRGS), Brazil
[d] Programa de Pós Graduação em Ciências da Saúde, Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA), Brazil

ARTICLE INFO

Article history:
Received 22 April 2014
Received in revised form 14 June 2014
Accepted 19 June 2014
Available online

Keywords:
Electromyography
Motor control
Posture
Rehabilitation
Neurodevelopmental treatment

ABSTRACT

This study aimed to investigate the electromyographic (EMG) activation of the main cervical muscles involved in the head control during two postures widely used for the facilitation of head control in children with Cerebral Palsy (CP). A crossover trial involving 31 children with clinical diagnosis of CP and spastic quadriplegia was conducted. Electromyography was used to measure muscular activity in randomized postures. Three positions were at rest: (a) lateral decubitus, (b) ventral decubitus on the floor and (c) ventral decubitus on the wedge. Handlings for facilitating the head control were performed using the hip joint as key point of control in two postures: (a) lateral decubitus and (b) ventral decubitus on wedge. All children underwent standardized handlings, performed by the same researcher with experience in the neurodevelopmental treatment. EMG signal was recorded from muscles involved in the head control (paraspinal and sternocleidomastoid muscles) in sagittal, frontal and transverse planes, at the fourth cervical vertebra (C4), tenth thoracic vertebra (T10) and sternocleidomastoid muscle (SCM) levels. The results showed a significant increase in muscle activation when handling was performed in the lateral decubitus at C4 ($P < 0.001$), T10 ($P < 0.001$) and SCM ($P = 0.02$) levels. A significant higher muscle activation was observed when handling was performed in lateral decubitus when compared to ventral decubitus at C4 level ($P < 0.001$). Handling in ventral decubitus also induced an increase in EMG activation at T10 ($P = 0.018$) and SCM ($P = 0.004$) levels but not at C4 level ($P = 0.38$). In conclusion, handlings performed in both positions may induce the facilitation of head control, as evaluated by the activity of cervical and upper trunk muscles. Handling performed in lateral decubitus may induce a slightly better facilitation of head control. These findings contribute to evidence-based physiotherapy practice for the rehabilitation of severely spastic quadriplegic CP children.

* Corresponding author at: Departamento de Fisioterapia, Universidade Federal de Ciências da Saúde de Porto Alegre – UFCSPA, Rua Sarmento Leite, 245, 90050-170 – Porto Alegre, RS, Brazil. Tel.: +55 51 3303 8876.
E-mail addresses: alinespagnussat@gmail.com, alinesp@ufcspa.edu.br (A.d.S. Pagnussat).

http://dx.doi.org/10.1016/j.ridd.2014.06.018
0891-4222/

1. Introduction

Cerebral Palsy (CP) is a term which encompasses a large group of childhood movement and posture disorders and is a syndrome of motor impairment that results from a lesion occurring in developing brains (Chen, Tseng, Shieh, Lu, & Huang, 2014; Colver, Fairhurst, & Pharoah, 2013). The disorder varies in clinical presentation, site and severity of impairments (Moreno-De-Luca, Ledbetter, & Martin, 2012). The overall prevalence has remained stable in the past 40 years at 1.5–2.5 cases per 1000 live births, despite changes in prenatal and perinatal care (Chen et al., 2014; Moreno-De-Luca et al., 2012; Stevens, Holbrook, Fuller, & Morgan, 2010). Further, it is estimated that the incidence of CP in developing countries is from 7 to 1000 live births, and this higher incidence is attributed to poor conditions of prenatal care and primary-natal care for pregnant women (Brazil, 2013).

Spastic quadriplegia is the most severe form of CP impairments that includes spasticity and stiffness affecting both arms and legs, and is often associated with moderate-to-severe intellectual disability (Reid, Carlin, & Reddihough, 2011). Children will often have abnormal movements and demonstrate clinical deficits on assessments of gross and fine motor activity affecting functional activity and participation (Chen et al., 2010; Straub & Obrzut, 2009).

One of the key features of children with spastic quadriplegia is the deficient postural control and unsupported neck in spite of limb spasticity. Development of postural control is a complex, long-term process and accordingly vulnerable to adverse conditions during early life (Brogren, Hadders-Algra, & Forssberg, 1998; Heyrman et al., 2013; Liu, Zaino, & McCoy, 2007; van der Heide et al., 2004). Head stabilization is one of the primary goals for postural control. The motor skill for head control takes quite a while to master, and it is necessary for attaining the complex sensorimotor coordination involving eye, hand and trunk control to achieve an upright sitting position or reach to grasp an object, for instance (Rachwani et al., 2013; Saavedra, Joshi, Woollacott, & van Donkelaar, 2009). The sensory organs for visual and vestibular systems located in the head make the refined head control of critical importance for both orientation and balance (Saavedra, Woollacott, & van Donkelaar, 2010; Wallard, Bril, Dietrich, Kerlirzin, & Bredin, 2012).

Noninvasive rehabilitation strategies for children with spastic quadriplegia are routinely used to improve motor function, activity, and participation. Most physical therapies are based on the principles of neuroplasticity, postural control and balance, muscle strengthening or stretching (Galea, 2012; Koman, Smith, & Shilt, 2004; Papavasiliou, 2009). Therapeutic intervention aims to maximize the children's potential to acquire functional skills that will enable them to perform activities of daily living and effectively participate in the society. In the majority of severely affected children, this may include working toward improving their postural control to acquire basic activities, such as the ability to hold their head up (Himmelmann, Beckung, Hagberg, & Uvebrant, 2007).

Approaches used for rehabilitation of CP children are varied. Currently evidence that supports the efficacy of one method of treatment over others is scarce, and may reflect the innate difficulties of research into such a heterogeneous population as CP (Barber, 2008). The most traditional method used for the purpose of reducing abnormal patterns of movement and promoting the maximal functional independence in spastic quadriplegic CP children is the Bobath concept, also called Neurodevelopmental Treatment (NDT) (Veličković & Perat, 2005). NDT aims to normalize muscle tone, inhibit primitive and abnormal reflexes and facilitate normal movements. Handlings can influence, and at the same time, be used to facilitate normal movement patterns or specific stimulation. Therapists are able to control and guide movement of the whole body through the key control points, i.e. using specific handling, they apply pressure at certain points on the body, which will facilitate reactions for the active control of the head and trunk (Bower, 1999; Veličković & Perat, 2005).

In clinical practice, physiotherapists recognize positive results of the use of handlings based on NDT, however, there are few clinical trials approaching scientific evidence (Bakhtiary & Fatemy, 2008; Kollen, 2009; Choi, Lee, & Ro, 2011). Clinical research evaluating muscle activation after facilitation handlings in severe CP children is scarce. Therefore, it has become necessary to quantify the effects offered by this modality of therapy.

According to this background, the first aim of this study was to examine the electromyographic activity of the main cervical and upper trunk muscles involved in the head control during two facilitation postures in spastic quadriplegic CP children. The second aim was to assess whether these muscle activities would vary according to different severity levels based on the Gross Motor Function Classification System (GMFCS).

2. Materials and methods

2.1. Participants

For this research, 35 children were recruited according to the following inclusion criteria: (a) diagnosis of CP with topography distribution of tone in spastic quadriplegic CP (Straub & Obrzut, 2009), (b) aged between three and twelve years, (c) unstable or absent head control, in accordance with motor level classified as IV or V in the GMFCS (Palisano et al., 2009). The exclusion criteria were: (a) children with other CP types, (b) motor level I to level III, according to the GMFCS and (c) botulinum toxin injection within 6 months prior to study entry. Before clinical trials commenced, the number of participants was finalized at 31 children. During the study period, children were evaluated at Federal University of Health Sciences of Porto Alegre – affiliated Rehabilitation Centers.