Photobiomodulation effect on the masseter muscle in children with cerebral palsy: a case report

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ABSTRACT

Spasticity causes stiffness in the masticatory muscles of individuals with cerebral palsy (CP), affecting the amplitude of mouth opening, making oral hygiene conditions difficult and predisposing these individuals to the risk of developing oral diseases. **Objective:** To evaluate the effect of a low-intensity photobiomodulation diode laser on the thick part of the masseter muscle in a child with spastic type CP. **Method:** The caregiver reported that the child had great difficulty in performing the oral hygiene, making avoidance movements of the head when the toothbrush touched the mucosa of the upper molar region in the mouth. The mother described the child's discomfort as extreme. The first ultrasound evaluation was performed at the first appointment, and the second evaluation after 6 sessions of photobiostimulation. The low-intensity Infrared Laser Diode, Ga-As-Al, was employed ($\lambda = 808 \pm 3$ nm, 120 mW; Twin Flex Evolution Laser MMOptics São Paulo, Brazil), using 5.0 J/cm^2 dose energy/location, with 20 seconds exposure/site. The area of the masseter muscle was bilaterally irradiated towards the midpoint of its length and width. Six sessions were performed, with an interval of 7 days between them. **Results:** At the end of the sixth session of photobiostimulation, the mother reported that the child slept better, had reduction in involuntary movements performed by the jaw, and oral hygiene was possible now with no painful expression of the child. During palpation there was less stiffness in the bilateral masseter and an increased masseter thickness and increase in the amplitude of the mouth opening of 7 mm. **Conclusion:** The diode laser photobiostimulation appears to be effective in reducing spasticity in the masseter muscle of children with spastic type CP.

Keywords: Cerebral Palsy, Masseter Muscle, Ultrasonography, Lasers

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INTRODUCTION

The muscular hypertonia observed in individuals with spastic type cerebral palsy (CP) entails abnormal muscular relaxation, hyperactivity in the myotatic reflex, and muscular debilitation.[1] It affects the masticatory, facial, and cervical muscles (medial pterygoid, lateral pterygoid, temporal, masseter, suprahyoid, infrahyoid, orbicularis orbis, buccinator, sternocleidomastoid, suboccipital, and trapezius), responsible for mandibular movements such as: opening, closing, retrusion, protrusion, and lateral movement.[2] Therefore it is possible to observe the reduction in the interincisal distance that results in difficulties in feeding and oral hygiene procedures.[3,4]

CASE REPORT

The person responsible for the child signed the Terms of Informed Consent following the norms based on the Resolution CNS 466/12 of the *Conselho Nacional de Saúde do Ministério da Saúde* (Brazilian Council of the Health Ministry), and the project was approved by the Ethics Committee of the Association for the Assistance to Deficient Children/Brazil Platform under Nº CAAE 33580214.9.0000.0085.

The objective of this report was to evaluate the effect of photobiomodulation using a low intensity laser diode on the thickness of the spastic masseter muscle.

Patient KPO, a 12-year-old male, diagnosed with spastic tetraparesis CP, appears at the Odontological clinic of the Association for the Assistance to Deficient Children (AADC) in Ibirapuera for a routine appointment in May of 2014.

The medical records show a gastrostomy being performed at 3 months of age, which has been used exclusively until now. A tracheotomy was performed in December of 2012. A cranial CT-scan done on June 14, 2013 describes reduced volume and density of the cerebral parenchyma, areas isodense to the cerebro-spinal fluid (gliosis/malacia), which may correspond to sequelae of severe neonatal hypoxia. Cerebellum and trunk normal, ventricles III & IV normal. Dilation of the symmetrical lateral ventricles (no hypertensive signs). Convulsion (only febrile), and taking phenobarbital (100 mg/day), amitriptyline hydrochloride (25 mg/day), esomeprazole magnesium trihydrate (20 mg/day) due to gastro-esophageal reflux, and baclofen (10 mg 3x/day). There was also a description of hypersalivation and nocturnal dependence on oxygen in the form of nebulization, however, there was no use of CPAP. There was no odontological history, the previous appointment was on December 4, 2013.

During anamnesis the mother reported great difficulty in performing oral hygiene, done twice a day, with the child showing avoidance movements when the head of the toothbrush pressed on the upper molar region of the masticatory muscles. The mother characterized the child's discomfort as extreme.

The extra-oral physical examination observed the child as wheelchair-bound, with no cervical control, and tracheostomized. The intra-oral physical examination observed permanent dentition, free of any caries, gingivitis, or oral lesions. There was great difficulty in opening the mouth due to spasticity. Palpation confirmed painful bilateral trigger points (of greatest muscular contraction) at the masseter muscles (observed by the facial expressions of frowning and closing the eyes), and an interincisal opening of 24 mm.

Since oral and dental conditions did not call for any odontological procedures, no oral hygiene intervention or odontological treatment was done. Kinesiotherapy was not performed.

Ultrasonography was encouraged to evaluate the effectiveness of photobiostimulation on the spastic masseter muscle. The thickness of the masseter muscle was thus evaluated using the methodology proposed by Satiroglu et al.[5] The examinations were made by a single radiologist at the Diagnostic Center of the Association for the Assistance to Deficient Children in Ibirapuera, using the ACUSON X300 (SIMENS) portable equipment.

To obtain the images, the transducer was positioned perpendicular to the skin, avoiding excessive pressure. The measurements were taken on the most voluminous portion of the masseter, proximal to the occlusal plane, approximately in the center of the medio-lateral region of the distance from the segment/branch. The images and measurements were made bilaterally with the child in a sitting position with his head straight and supported manually at the jaw, at rest (habitual position).

The initial ultrasonographic evaluation of the right and left masseters was done before the first application of photobiostimulation (Figure 1). The interval between applications was seven days and there were a total of six photobiostimulation sessions. At the end of the sixth application, a new ultrasonographic evaluation was performed on the same muscles (Figure 2). The interincisal opening was evaluated with the help of a caliper supported on the occlusal face of the upper and lower incisors. The clinical parameters can be observed in Chart 1.

A low-intensity As-Ga-Al diode laser was used (λ = 808 ± 3 nm, 120 mW); Twin Flex Evolution Laser MMOptics São Paulo, Brazil), using 5 J/cm^2 energy dose/location, with an exposure of 20 seconds/site. The bilaterally irradiated area of the masseter muscle was the mid-point of its length and width.

At the end of the sixth photobiostimulation session, the mother reported that the child was sleeping better, showed a reduction in the number of involuntary jaw movements, and oral hygiene was now possible with no pained expression on the child's face. During palpation, less hypertonia was observed in the bilateral masseter and an interincisal opening of 31mm was now recorded.

DISCUSSION

This is the first report until now to evaluate the effects of photobiostimulation on the masticatory muscles of a child with spastic CP. Laser therapy was observed to be an effective, non-invasive therapeutic modality, able to promote the relaxation of spastic masticatory muscles, resulting in an increased thickness of the bilateral masseter muscle and an increased mouth opening.

This increase in mouth opening and reduction in muscular tonus in individuals with spastic CP are described in the literature as effective diagnostic parameters when cryotherapy[6] and botulinum toxin[7] were used. In this way we can infer that photobiostimulation is also an effective form of treatment, as it provides the effects of muscular relaxation evaluated either by means of the qualitative results described by the person responsible for the minor (with an improvement in the quality of life and quality of sleep, facilitation of brushing the teeth, and the reduction of drooling), or by quantitative results as measured by the increase in thickness of the bilateral muscle and increase in interincisal distance.

The properties of photobiostimulation open new dimensions of treatment in a variety of clinical procedures.[8] It can provide ergogenic effects, improving the contractile function of skeletal muscles, which, when

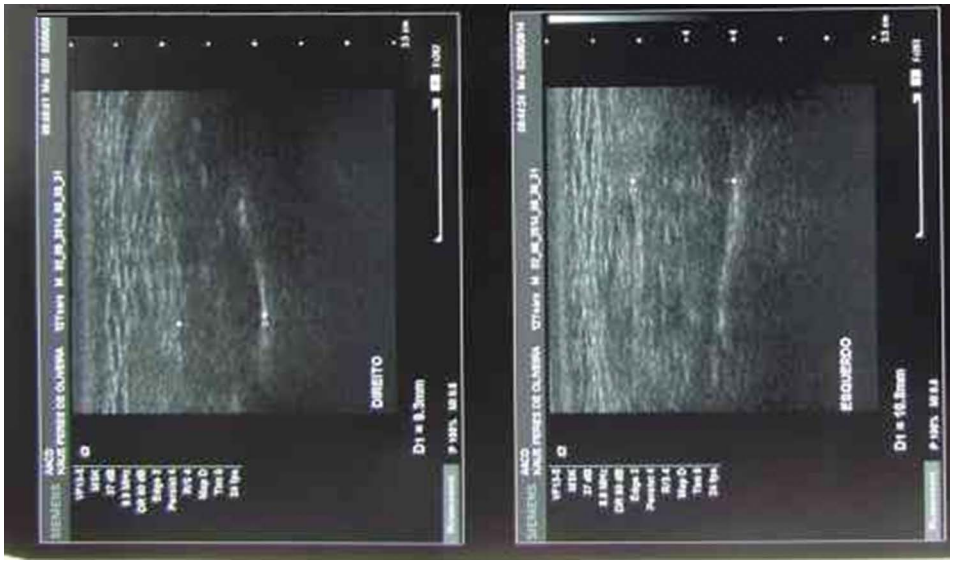

Figure 1. Thickness of the left and right masseters before photobiostimulation

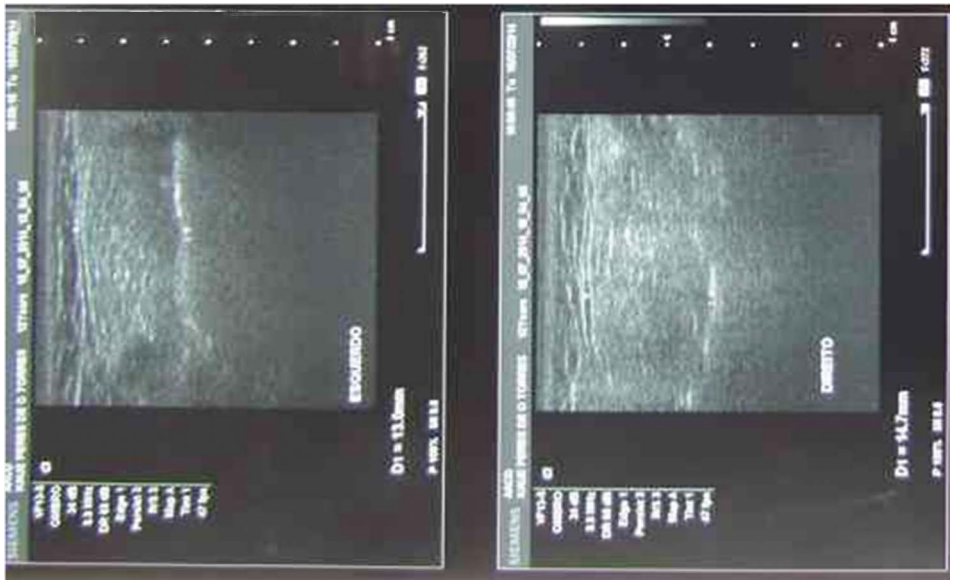

Figure 2. Thickness of the left and right masseters after photobiostimulation

Chart 1. Values in millimeters of the thickness of the right and left masseter muscles and the interincisal distances before and after photobiostimulation

Data	June 2, 2014 (Figure 1)	July 16, 2014 (Figure 2)
Right masseter	9.3 mm	14.7 mm
Left masseter	10.8 mm	13.0 mm
Interincisal distance	24 mm	31 mm

exposed to the laser had presented lower levels of blood lactate and of the activity of the CK after repeated tetanic contractions.[9] The use of low-intensity laser has been described as reducing the electrical excitability in cell cultures. These factors explain the relaxation effect observed after photobiostimulation. This could also explain the reduction of painful muscle sensitivity at the touch of a toothbrush since the spasticity afflicts the masticatory muscle and not the periodontal tissues of affixation and support of the dental elements. And also confirmed the clinical odontological examination of absence of dentogingival alterations.

Pharmacological and non-pharmacological treatments are used to deal with spasticity on individuals with CP. However, most of the drugs used are known for causing the development of side effects, mainly owing to the need for elevated doses.[10] Chemical denervation agents (botulinum toxins, phenol, and alcohol) are also used to treat localized spasticity.[7] However, the literature is scarce on the treatment of masticatory muscle spasticity in individuals with CP.[3]

Due to the proven capability of infrared radiation to improve cellular metabolic energy,[11] laser therapy is already in use in physical sports medicine to accelerate muscle recovery[12] and to prevent damage from metabolic disturbances and inflammatory reactions following heavy exercise.[13] Following the application of photobiostimulation of tissues, a selective stimulation of mitochondrial activity is seen to occur, providing more elevated levels of cellular respiration as well as the synthesis of ATP, which results in the acceleration of mitosis.[14,15]

An energy density of 5J/cm^2 was chosen for the application at each point where there was the greatest muscle contraction reaction (deep muscle fibers) to palpation of the muscles selected for this report. The laser radiation was maintained for 20 seconds at each site for six sessions. These parameters are in accordance with previous studies that demonstrated that six to ten low-intensity laser applications were sufficient to increase the metabolic standard of the muscle fibers.[13] According to basic studies on low-intensity laser therapy, greater efficacy was demonstrated when the laser is in contact with the biological tissue on a precise point-by-point basis for 20 to 30 seconds,[15] as was applied in the present study.

It is possible that low-intensity laser therapy influences the excitability of muscle fibers and indirectly reduces muscle fatigue by modulating the Na^+/K^+ pump that is ATP dependent. ATP synthesis by the mitochondria that surround the T-tubules, the Ca^{+2}, and the cisternae can increase as a result of the low-intensity laser therapy. This greater availability of ATP can improve the function of this pump and avoid an accumulation of extracellular K^+,[16] which could be an explanation for the results found in this study.

The information contained in this case study becomes important to the degree that it suggests a possibility for a painless, non-invasive therapy to reduce the clinical consequences of spasticity in individuals with CP. It must also be pointed out that these findings are important to the odontological treatment of patients with spastic CP, since photobiostimulation promotes an increase in interincisal distance allowing access to faces of upper and lower posterior molars. However, it is known that a case report is a type of study that does not allow the extrapolation of its results, which stands as the limitation of this study. However, the presentation of these results is important in order for future studies on this therapy to be made.

CONCLUSION

The results of this study suggest that photobiostimulation by laser diode may be effective in reducing spasticity in the masseter muscle.

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