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Lower-level laser therapy improves neurosensory disorders resulting from bilateral mandibular sagittal split osteotomy: A randomized crossover clinical trial

Giovanni Gasperini*, Isabel Cristina Rodrigues de Siqueira, Luciane Rezende Costa

Department of Oral and Maxillofacial Surgery (Dr. Giovanni Gasperini, Ms), UFG Hospital, Primeira Avenida, s/n – Setor Universitário, 74605-020 Goiania, Goias, Brazil

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SUMMARY

Bilateral sagittal split osteotomy (BSSO) is a technique commonly used to correct mandibular disproportion but many patients experience hypoaesthesia of the inferior alveolar nerve (IAN). The purpose of this study was to verify the effectiveness of using a low-level laser therapy protocol after BSSO. The 10 patients in our study, who underwent BSSO with Le Fort I osteotomy and had low-level laser therapy on one side of the jaw, were evaluated over a period of 60 days. The data for the treated and non-treated sides were compared post-operatively. At 15, 30 and 60 days after surgery, when sensitivity was recovered on both sides. On the treated side, recovery was faster and was almost complete at the time of the last evaluation. We suggest that this lower-level laser therapy protocol can improve tissue response and accelerate the recovery of neurosensory disorders following BSSO. (NCT01530100).

1. Introduction

Bilateral sagittal split osteotomy (BSSO) is a versatile technique first described by Trauner and Obwegeser in 1957 for correcting mandibular disproportion. Over the years, many modifications have been introduced, such as those by Dal Pont (1961), Hunsuck (1968), and Epker (1977). The purpose of these changes is to improve stability and reduce surgical complications.

The sensory nerve to the lower lip is the inferior alveolar nerve (IAN) which runs through the lower jaw in the region of the osteotomy cuts. After the surgery, many patients experience hypoaesthesia of the lower lip and chin, which improves over a period of months. Studies report an 8.9–100% incidence of neurosensory disturbance immediately after BSSO (Becelli et al., 2002; Yoshioka et al., 2010; Yoshioka et al., 2011; Mensink et al., 2012; Yoshioka et al., 2012; Aizenbud et al., 2012).

Neurosensory disturbance of peripheral innervation remains a complex problem and is not always easily resolved. Treatment may consist of systemic administration of medication, physiotherapy, local electrical stimulation, nerve repair surgery, low-intensity laser application and other therapies such as acupuncture (Leung et al., 2012).

Low-level laser therapy (LLLT) has been described in the literature as producing a biomodulatory effect and is indicated in cases of pain and tissue repair. Low-level laser irradiation of the affected innervation path has been shown to result in sensory improvement (Khullar et al., 1996; Miloro and Repasky, 2000; Ladalardo et al., 2001; Enwemeka et al., 2004; Espitalier et al., 2011). The advantages of LLLT include no contraindications, no adverse effects, easy application and easy handling of the apparatus. To penetrate the tissue, the energy delivered through a low-intensity laser device undergoes multiple scattering, which affects its distribution. Absorption of this energy stimulates or inhibits enzymatic activities and photochemical reactions that induce cascades of reactions and physiological processes with therapeutic connotations. In this way, the laser mediates inflammation and activates the immune system with broad therapeutic effects (Reddy, 2004).

There is very little in the literature about low-intensity laser therapy for recovery from BSSO-related neurosensory disorders and there are no studies comparing the treated and non-treated sides in the same patient. For this reason, the aim of this study is to evaluate an LLLT application protocol for shortening the process of recovery from neurosensory disorders resulting from BSSO.

* Corresponding author. Rua 145, número 263, Setor Marista, 74170-080 Goiânia, Goiás, Brazil. Tel.: +55 62 30914020.
E-mail address: gasperinibuco@gmail.com (G. Gasperini).

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2. Material and methods

This randomized, crossover, double-blind clinical trial study was approved by the Research Ethics Board of the University Hospital, Federal University of Goias (protocol # 101/2011) and registered as a clinical trial (protocol # NCT 01530100). All subjects signed an informed consent form to undergo the treatment. The surgical treatment was performed at the Oral and Maxillofacial Department of the University Hospital with 10 healthy women (age range, 18–54 years; mean age, 30 years) who underwent bimaxillary surgery (Le Fort I osteotomy and bilateral sagittal split osteotomy) to correct dentofacial deformities. Patient selection criteria were: no facial trauma or IAN injury; no neurosensory disturbance before treatment; similar sagittal split on left and right sides according to time and IAN minimal manipulation; no genioplasty. Third molars were removed at least 6 months before the orthognathic surgery Exclusion criteria were neurovascular bundle rupture; a BSSO bad split; post-operative infection or absence of laser application. All patients met the criteria without any exclusion. Sample size was determined by the statistical behaviour of the results.

All patients underwent pre-operative orthodontic treatment to align the dentition. All patients were operated on by the same senior staff. Four of the procedures involved maxillary superior reposition and mandibular advancement, with mean maxillary impaction of 4 mm and mean mandibular advancement of 6 mm. The other six procedures involved maxillary advancement mean of 5 mm, and mandibular setback, mean of 3 mm.

Six points were marked symmetrically on the lower lip (Fig. 1) and labiomental sensation was evaluated pre-operatively by two-point discrimination (a 25 × 7 needle was used to determine the shortest distance in millimetres that the patient could feel the two punctures) and a sensory test (the same needle was used to stimulate the six points and the sensation reported was assigned a score, with 3 being normal perception). Mean scores for each region were calculated and the data were collected and stored for comparison with postoperative data.

2.1. Surgical procedure

The pre, trans and post-operative medications were standardized and dosed according to patients' weight in order to maintain the same proportion of drugs. All patients received anti-microbial prophylaxis (cefazolin pre-operatively), steroids (hydrocortisone pre-operatively, dexamethasone post-operatively until the third day after surgery) and analgesics (tramadol pre-operatively and every 8 h for 24 h after admission and ketorolac) until 48 h after the operation.

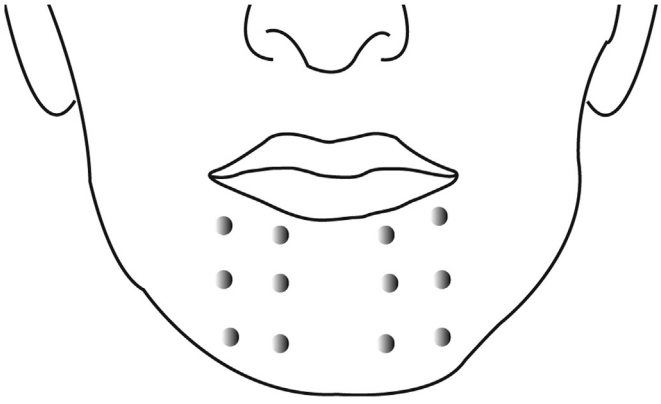

Fig. 1. Six points symmetrically marked to evaluated labiomental sensation.

The BSSO technique was performed using the principles of Trauner and Obwegeser (1957) modified by Epker (1977). The mandibular ramus was exposed and the IAN nerve was exposed from the lingual aspect of the mandibular foramen. The horizontal and vertical bone cuts were performed with a 703 bur. The sagittal cut was performed with a sagittal saw. Splitting was initiated with a chisel sequence driven directly into the sagittal cut in contact with the external cortical bone to minimize IAN injuries. Following this splitting forceps were positioned in the sagittal bone cut and an elevator was positioned in the vertical bone cut. The mandibular split was completed carefully and the bone gap was inspected to identify the inferior alveolar neurovascular bundle.

The mandible was repositioned using a surgical splint and maxillomandibular fixation (MMF) was performed. The proximal segment was positioned manually, a four-hole upper border miniplate with 6 mm monocortical screws was placed to stabilize the BSSO split and the MMF was removed.

2.2. Laser protocol

A gallium–aluminium–arsenide diode low-level laser device (Thera Laser, DMC Brazil, continuous wave, spot size 0.4 mm) was used. The laser therapy-exposed surface was cleaned and air dried before application. The applications were performed by another dentist.

One side, called the treated side, was randomly chosen for laser therapy by intraoral and extraoral exposure. Four points 1 cm from the surgical wound were exposed intraorally immediately after and at 24, 48 and 72 h after the surgery ($\lambda = 660$ nm (red), ED = 5 J/cm^2, $t = 10$ s/point, $P = 20$ mW, $E = 1.2$ J per point). Eight points on the mandibular ramus and body were exposed immediately after, and at 24, 48 and 72 h after the surgery ($\lambda = 789$ nm (infra-red), ED = 30 J/cm^2, $t = 20$ s/point, $P = 60$ mW, $E = 1.2$ J per point). Two points on the preauricular, jugular-digastric and submandibular lymph nodes were given the same exposure. Total energy used was 21.6 J per session.

After the fourth day, with an interval of 48 h, 3 points 1 cm from the surgical wound on the path of the inferior alveolar nerve in the mandibular ridge were given ten intraoral applications. In addition, 4 points on the lower labial mucosa, 2 points on the lower lip and 9 points in the chin region 1 cm from the surgical wound were exposed extraorally ($\lambda = 780$ nm (infrared), ED = 70 J/cm^2, $P = 70$ mW, $t = 40$ s/point, $E = 2.8$ J per point). Total energy used was 50.4 J per session.

On the other, non-treated side, the laser unit was positioned at the same points but the laser was not activated.

2.3. Assessment

One trained person blinded to the laser application, assessed the post-operative symptoms by repeating the same pre-operative test. The data collected were used to calculate each region's average score. The two-point discrimination test and sensory test were performed immediately post-operatively, 15 days, 30 days and 60 days after surgery. The sensory test stimulated the exposed points and the sensation reported was given a score of 3 for normal sensitivity, 2 for a stimulus which was perceived but not normal, 1 for perception of the stimulus but with no idea about the quality and 0 for no perception. Means were determined for each side during each specific period and the treated and non-treated sides were compared.

2.4. Statistical analysis

Data were entered into a Microsoft Excel spreadsheet by the same person who was blinded to the procedure, and imported into