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Efficacy of a single dose of low-level laser therapy in reducing pain, swelling, and trismus following third molar extraction surgery

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Abstract. The clinical efficacy of low-level laser therapy (LLLT) for the reduction of pain, swelling, and trismus following the surgical extraction of third molars was evaluated. Mandibular third molars, with similar radiographic positions on two distinct sections, were extracted from 22 patients. Immediately after extraction from the randomly selected right or left side, LLLT was applied (study group). The same extraction procedure was performed 21 days later on the other third molar, without the application of LLLT (control group). LLLT was applied at 10 points: four intraoral in close proximity to the socket and six extraoral along the masseter muscle. Pain intensity was assessed using a visual analogue scale, swelling was measured as the distance from the tragus to the median base of the mentum, and trismus was assessed by the extent of mouth opening. Data were collected at four time points: before surgery, immediately after surgery, 48 h postoperatively, and 7 days postoperatively. Compared with the control group, the study group showed significant reductions in pain, swelling, and trismus at 48 h and 7 days postoperatively. In conclusion, a single dose of LLLT was effective at reducing the postoperative discomforts (pain, swelling, and trismus) associated with third molar extraction surgery.

Key words: low-level laser therapy; pain; swelling; third molar; trismus.

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The extraction of third molars is one of the most common procedures performed in maxillofacial surgery.[1] Third molar removal requires intraoral access and is associated with several complications and postoperative morbidity.[2] The postoperative complications of third molar extraction surgery have been reported at varying incidences and include a wide range of symptoms, ranging from mild postoperative discomfort to more serious complications requiring additional treatment (such

as hospitalization), with the potential of permanent damage to the patient.[3] Precious and Mercier evaluated and classified the advantages and disadvantages of non-intervention versus intervention for impacted third molars.[4] Potential complications were classified as either minor transient (e.g., alveolitis, trismus, infection, haemorrhage, and dentoalveolar fractures) or major (e.g., permanent neurosensory changes and jaw fractures).

Most complications or postoperative discomforts—particularly pain, swelling, and trismus—are triggered by inflammatory processes initiated by surgical trauma.[5] Several methods have been utilized to minimize postoperative complications, such as the administration of local or systemic corticosteroids and anti-inflammatory drugs, different types of incisions, and low-level laser therapy (LLLT).[5–9]

The use of LLLT has demonstrated anti-swelling effects due to its direct action on the lymphatics (increased number) and blood vessels (decreased permeability). LLLT is an advantageous technique and, depending on the dose, wavelength, and condition of the target area, it can promote a variety of biological responses. These responses include the acceleration of tissue healing, improvements in bone repair, restoration of normal nerve function after injury, moderation of inflammatory responses, stimulation of analgesia, reduction of swelling, and regulation of the immune system.[10–14] Furthermore, LLLT enhances the absorption of proteins by activating macrophages, and modifies intracapillary hydrostatic pressure, inducing the absorption of interstitial fluid with a subsequent reduction in swelling.[15–17]

The aim of the present study was to evaluate the clinical efficacy of LLLT in reducing patient pain, swelling, and trismus after the surgical extraction of mandibular third molars.

Materials and methods

Patients

A cross-over trial involving 22 healthy patients older than 17 years of age, with partial or full bony impacted mandibular third molars based on published radiographic classifications,[18] was performed. The study was approved by the relevant institutional ethics committee and patients provided informed consent. The inclusion criteria were as follows: bilateral partial or full bony impacted third molars belonging to the same radiographic classification (determined using two distinct sections), good health status, and a clinical or radiographic indication for third molar extraction.

The patient's surgery type was classified postoperatively by the surgeon according to the following criteria: I, extraction with forceps only; II, extraction requiring osteotomy; III, extraction requiring osteotomy and coronal section; and IV, complex extraction (root section).[19]

Study design

Patients were assigned randomly to undergo extraction of either the left or the right third molar and LLLT was applied following the first or second surgical procedure (study group). After 21 days, the opposite third molar was extracted. The control group underwent routine postoperative management control only. Data were collected at four time points: before surgery (T0), immediately after surgery (T1), 48 h postoperatively (T2), and 7 days postoperatively (T3). The application of LLLT, performance of assessments, and data collection were performed by a non-blinded, independent investigator.

Surgical procedures

The same surgeon performed all surgical procedures and the duration of each surgery was recorded. Surgical procedures were performed under local anaesthesia using mepivacaine 2% with norepinephrine 1:100,000 (Mepinor 2%; DFL, Rio de Janeiro, Brazil). Nerve block of the inferior alveolar, buccal, and lingual nerves was also performed. An incision was made according to the position of the tooth and a mucoperiosteal flap was created. An osteotomy was performed around the impacted tooth using a round bur under constant irrigation with physiological saline solution. The cavity was treated and the socket was sutured (4–0 ProCare, Barueri, São Paulo, Brazil). Immediately after surgery, patients underwent LLLT (Ga–Al–As, Twin Laser; MM Optics, São Carlos, São Paulo, Brazil); laser energy was administered at 7.5 J/cm^2 with a power output of 10 mW and at an infrared wavelength of 780 nm. The administration of irradiation was not repeated during the postoperative period. The tip of the laser device was coated with one layer of a polyvinyl chloride film to prevent loss of energy by refraction or light absorption. Following surgery, LLLT was applied as a single dose at four intraoral points and six extraoral points. The intraoral points were situated around the surgical field on the buccal, distal, lingual, and middle parts of the bone socket (Fig. 1). The extraoral points were situated along the masseter muscle, two on the muscle origin, two on the muscle insertion, and two on the median length of the masseter; each set of points was 1 cm away from the others (Fig. 2).

All patients were prescribed amoxicillin 500 mg every 8 h for 7 days, ibuprofen 600 mg every 8 h for 3 days, and chlorhexidine antiseptic mouth wash twice daily for 7 days postoperatively, in accordance with the institutional protocol.

Assessments

The level of pain at T0, T1, T2, and T3 was assessed using a visual analogue scale (VAS), where 0 = no pain and 10 = worst pain imaginable. To assess postoperative swelling, the distance between the base of the chin and the lower part of the tragus was measured at T0, T1, T2, and T3. The swelling ratio (Ec) was calculated as follows: Ec = (postoperative measurement − preoperative measurement) × 100/preoperative measurement.[14] Trismus was evaluated at T0, T1, T2, and T3 by measuring the maximum mouth opening between the incisal edges of the upper and lower central incisors with a ruler.[8,20] Trismus was diagnosed in patients with a 10-mm mouth opening at 48 h and 7 days postoperatively.[14]

Statistical analysis

The following quantitative variables were calculated: mean, median, minimum and maximum values, and standard deviation. The study and control groups were compared using the Student *t*-test for paired samples or the non-parametric Wilcoxon test. Data at T0, T1, T2, and T3 were compared between the study and control groups using the non-parametric Friedman test. A *P*-value of less than 0.05 was considered statistically significant. Data were analysed using the software Statistica v.8.0 (StatSoft, Inc., Tulsa, OK, USA).

Results

Patients

In total, 90 patients were recruited into the study. Sixty-four of these patients were excluded because they did not fulfil the inclusion criteria; patients were excluded for reasons such as having third molars in different bilateral radiographic positions or lacking one of the mandibular third molars. Of the 26 patients included, four missed one of the follow-up sessions, resulting in a total of