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ORIGINAL ARTICLE

Clinical efficacy of low level laser therapy in reducing pain and swelling after periapical surgery. A preliminary report.

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Abstract: The objective of this study was to evaluate the efficacy of the low level laser therapy (LLLT) in postoperative pain and swelling associated with periapical surgery. A double-blind, randomized, controlled clinical trial was carried out in 2 groups of 10 patients each, undergoing periapical surgery. The experimental group was treated with an intraoral application of an 810 nm-GaAsAl-laser, having an output power of 100 mW, with overlapping movements over the wound. In the control group, the same procedure was carried out, without therapeutic laser activation. Postoperative pain, swelling, and rescue medication were registered. The experimental group exhibited a decrease in pain intensity after periapical surgery compared with control group ($p<0.05$). There was not significant statistical difference between the groups in terms of swelling. Six patients of the control group required rescue medication. The use of LLLT in the postoperative management of patients having periapical surgery, using the protocol of this study reduced postoperative pain.

Keywords: *LLLT; periapical surgery, pain, swelling.*
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INTRODUCTION.

Periapical surgery is directed to eliminate the etiology of periapical pathology, which is usually due to the presence of microorganisms. This procedure is mostly indicated when a nonsurgical retreatment is impractical or unlikely to improve the previous results[1,2]. Like all surgical procedures the main sequelae are pain and swelling, and both are widely studied to be minimized or controlled in this field[3]. The swelling reaches its maximum level between the first and second day after surgery, and the maximum intensity of pain generally occurs during the first 48 hours. Both changes progressively decreases toward the seventh day[4,5].

Different strategies have been used to control these postoperative sequelae, mainly using systemic corticosteroids and nonsteroidal anti-inflammatory drugs, alone or in combination. As an alternative, low energy level laser therapy (LLLT) reduces pain and swelling by means of cellular bio-stimulation, accelerating tissue regeneration and wound healing[6-8]. Also, it shows immune-stimulant effects and promotes cell proliferation[9,10]. The biological effects of laser were first studied in 1967 by Inyushin, and the concept of laser therapy began in 1970 when Mester applied it over chronic ulcers to accelerate healing[11]. Since then, it has been used in the treatment of temporomandibular disorders, chronic facial pain, periodontal surgical procedures, tooth hypersensitivity, chronic sinusitis, osseointegration, orthodontic pain reduction, pain after the removal of impacted third molars, sensory aberrations of the inferior alveolar nerve, management of recurrent aphthous stomatitis among others[12-18]. The biological effects of LLLT are partially produced when its energy is absorbed by the tissues, allowing photons' light to interact with the cellular structure, producing the expected therapeutic effect. The increased cellular energy and changes in cell membrane

permeability result in pain relief, wound healing, muscle relaxation, immune system modulation, and nerve regeneration[15]. Directly over primary nerve endings, LLLT favors the hyperpolarized state than inhibits the transmission of painful stimuli to central nervous system[8].

The aim of this study was to evaluate the efficacy of a LLLT in the control of postoperative pain and swelling associated with periapical surgery.

MATERIALS AND METHODS.

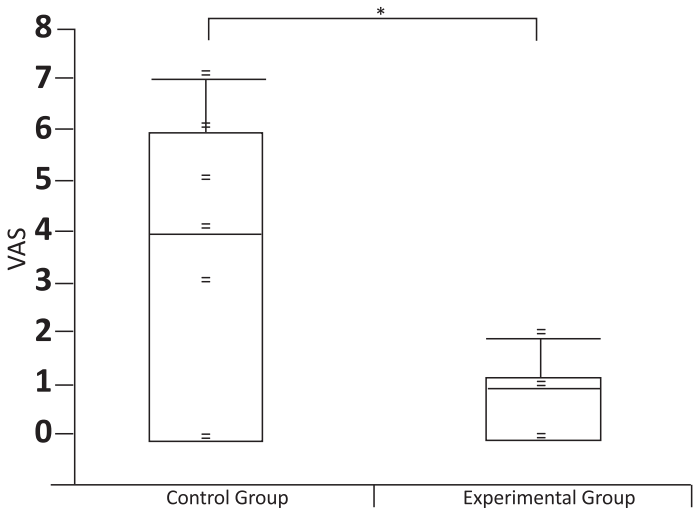
Twenty patients older than 18 years previously selected to periapical surgery were recruited and enrolled into the study. A double-blind, randomized, controlled clinical trial was conducted in accordance with the Declaration of Helsinki, and the institutional Ethics Committee approved the study (Code: CEIFE-008-010). After being informed of the risks of the procedures and the treatment to be performed, all participants were asked to accept and signed the informed consent form. The patient's inclusion criteria were as follows: systemically healthy persons of both genders, which age was between 18 to 30 years old, and who were indicate to periapical surgery (apicoectomy). Exclusion criteria were as follows: Patients who suffer of high blood pressure or uncontrolled diabetes, who received previously a pacemaker o vascular surgery, or with history of neoplasm. Pregnant patients or in breeding period were excluded as well.

Selected patients were assigned sequential numbers in order of enrollment to receive their allocated treatment according to a computer-generated. Patients were randomized into 2 treatment groups, each with 10 patients—an experimental group (laser) and control group (nonlaser)—and were told to avoid any analgesic 12 hours before surgery. The experimental group received LLLT and the control group only routine management.

For all surgical procedures, the patients washed their mouths with an antiseptic rinse (Colgate Plax, Colgate-Palmolive, Mexico). Each procedure was done under local anesthesia using two 1.8-mL capsules of 2% mepivacaine containing 1:100,000 epinephrine (Scandonest; Septodont, Saint-Maur-des-Fosses, France); using a full-thickness flap design to each surgical site, avoiding the manipulation of gingival margins. The flap design was carried out using a surgical blade # 10, and the osteotomy was done using a No. 4 round carbide bur; for the apicoectomy, a No. 701 fissure bur was used. This was followed by retro-preparation with ultrasound and retrograde filling with mineral trioxide aggregate (MTA; Angelus, Londrina, Brazil). Black silk 4-0 suture was used to finish the surgical procedure.

Subsequently to suturing, a GaAsAl therapeutic laser with 810-nm wavelength diode, power output of 100 mW (0.1 W) (Quantum IR 810; Laser Systems, Queretaro, Mexico) was applied intraorally for a total of 150 seconds, using an overlapping movement at a distance of 1cm from the involved area. Laser application was performed once, by a third person. In the control group, the laser was inserted intraorally over the operated site for the same time, but it was not activated. Patients were blinded as to which treatment they were allocated. Postoperatively, patients received amoxicillin 500mg (Sanfer, Mexico) orally every 8 hours for 7 days. In case of intense pain, ibuprofen 600mg (Pfizer, Mexico) was prescribed as rescue medication. All surgical procedures were carried out by the same surgeon, and evaluations were done by an independent investigator.

Figure 1. Boxplot showing the intensity of pain at 24 hours follow-up period of study.



*Statistically significant; p<0.05, Mann-Whitney U test.

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Postoperative pain, swelling, and rescue medication were registered in both groups. The visual analogue scale (VAS) consisted of a 10-cm horizontal line, anchored at one end by the label "No pain" and the other end by "Worst possible pain." At 24 hours, the patient marked on the line the spot for pain intensity, which was then measured[19]. The level of swelling was evaluated by visual scale as follows: 0=No inflammation; 1=Visible intraoral inflammation; 2=Visible extraoral inflammation; 3=Massive inflammation. Intraoperative and postoperative complications were also registered.

For the statistical analysis and comparison among groups for continuous variables, the Mann-Whitney *U* test was used, and for categorical variables, the Fisher exact test was employed. A *p* value less than .05 was considered statistically significant.

RESULTS.

Twenty patients were included in the study and all completed the follow-up period. Demographic characteristics of the sample were similar between the two groups for age and gender. Variables describing the difficulty of the surgical procedure such as type of tooth treated, and duration of surgical procedure were also similar between groups (Table 1).

There was difference in the intensity of pain between the two groups using VAS after 24 hours of the surgery. Intensity of pain elicited in the laser group [1.00 (mean); 0.25-1.30 (range)] was significantly lower than that in nonlaser group [(4.00 (mean); 1.50-5.40 (range)] ($p<0.05$) as observed in Fig. 1.

In the other hand, patients of the laser group presented less swelling than the nonlaser group, but without significant statistical difference ($p>0.05$; Table 2). Six patients of the nonlaser group required rescue medication (Table 2).

Table 1. Summary of demographic and surgical variables.

Group	Sample Size	Median Age (Range)	Gender (Female/ Male)	Teeth (Anterior/Premolars/Molars)	Duration of Surgery* (Range)
Laser	10	45 (20-55)	6 / 4	2 / 3 / 5	60 (40-90)
Nonlaser	10	47 (24-59)	5 / 5	1 / 4 / 5	60 (40-90)
p value		>0.05	>0.05	>0.05	>0.05

* Time in minutes.

Table 2. Swelling and rescue medication.

Group	Sample Size	Swelling Grade* 0 / 1 / 2 / 3	Rescue Medication YES / NO
Laser	10	0 / 5 / 5 / 0	0 / 10
Nonlaser	10	0 / 3/ 7 / 0	6 / 4
p value		>0.05	<0.05

*0 = No inflammation; 1 = Visible intraoral inflammation; 2 = Visible extraoral inflammation; 3 = Massive inflammation

DISCUSSION.

Potential benefits of LLLT in apical surgery were presented in this study. In patients from the laser group, the intensity of pain was lower than that in nonlaser group. It is known that all oral surgical procedures produce secondary effects such as pain and swelling, the magnitude of which depends on the degree of tissue damage. Different alternatives have been used for pain and swelling relief including drugs and laser therapy[9,10,20]. Controversy over bio-stimulation of tissue induced by LLLT therapy still exists. A lack of uniform related to laser physical and biological variables (such as output power, pulse frequency, wavelength, time and mode of application, distance of source from irradiated tissue, and histological tissue di-

fferences and absorption characteristics) make standardization and interpretation of the results difficult[8].

Pain relief after periapical surgery was obtained by irradiating the surgical site area after suture placement. It is known that LLLT reduces pain and inflammation, and accelerates wound healing in cell cultures, animal studies, and human clinical studies[8]. In reference to the anti-inflammatory and anti-edematous effects, laser accelerates exudate resorption, decreasing liquid pressure over the peripheral nerve endings[20]. Some of the irradiation parameters used in this study were similar to those applied by Kreisler *et at.*[6], the same type of laser (GaAsAl), distance to the irradiated tissue (approximately 1cm between fiber and tissue), number of times the therapeutic laser was applied (only one occasion), irradiation time (150 seconds), and application mode (overlapping movements over the surgical area). They showed that the pain level in the laser group was lower than that in the control group, with significant statistical difference on the first day postsurgery and attributed this outcome to a vanishing laser effect after 24 hours. A similar result was observed in the present study.

Most of studies that evaluate the effect of LLLT in reducing postoperative pain and swelling are based on surgical removal of impacted third molars. Amarillas *et al.*[17] investigated the effect of the LLLT (810-nm), with a power of 100 mW and an energy of 4 J/cm^2 in 2 groups of 15 patients, each after removal of impacted mandibular third molars for pain control, inflammation, and trismus. The experimental group was subjected to laser treatment during different periods of time, namely, 0, 24, 48, and 72 hours postsurgery. The use of therapeutic laser reduces postoperative pain, swelling, and trismus, without statistically significant differences. El-Soud *et al.*[21] evaluated the efficiency of LLLT in pain reduction after simple third molar removal in 60 patients, 30 receiving soft laser application with a wavelength of 870 nm, energy of 4 J/cm^2, and power of 50 mW at a distance of 1cm for 10 minutes; the other 30 patients receiving only simulated laser treatment. The patients were instructed to evaluate postsurgical pain 7 days after third molar removal using the VAS before taking any analgesics. The results showed that the pain level was lower in the group receiving laser than in the control group, indicating that the use of LLLT after simple third molar removal significantly reduces postsurgical pain. When more profound surgeries are evaluated, such as orthognatic surgery, LLLT shows important benefits in pain and inflammation responses not immediately but after 24 hours[22]. However, only few studies are conducted to evaluate the effect of LLLT in reducing pain and swelling after periapical surgery. Payer *et al.*[9] evaluated the clinical effect of LLLT on endodontic surgery, using a diode laser Minilaser 2075 F with a power of 75 mW and an energy of 3 to 4 J/cm^2 after endodontic surgery. They concluded that in routine endodontic surgery cases, LLLT does not achieve a significant clinical benefit. Kreisler *et al.*[6] evaluated the effect of LLLT on postoperative pain after endodontic surgery in a double blind randomized clinical trial, and as our study, they reported that the pain level in the laser group was lower than in the placebo group throughout the seven days follow-up period. Jovanovic *et al.*[20] evaluated the effect of LLLT in pain after root resection and concluded that this therapy induces certain analgesic potential. Under such context, it is showed that complete certain evidence is not available, and that controversy of the potential aid of LLLT in dental surgery is a strong reason to keep development new well design trials in this area. This situation was recently discussed by Brignardello-Petersen *et al.*[23], in a meta-analysis study that demonstrate low standardize studies and not enough evidence to support the effect of LLLT to reduce pain and swelling in third molar surgery.

The present experimental design included protective strategies for the patient. All of them had access to rescue analgesia if needed, and it was considered as another effect variable. In that sense, the consumption of rescue ibuprofen in the laser group was statistically lower than in the control group (nonlaser). The analgesic rescue medication can be considered as an indirect measure of

efficacy; since when lower symptoms are present, lesser medication intake. As one of the LLLT benefits, the avoidance of medication intake (and accordingly the possibility of side effects occurrence) is an important aspect to consider.

CONCLUSION.

The main finding of our study is that, in patients undergoing periapical surgery, GaAsAl LLLT under the parameters used resulted in a significant reduction of pain and in a perceptible decrease in swelling compared with the control group, in addition to lesser rescue medication needed. This study suggests that therapeutic laser is an alternative for acute pain treatment following periapical surgery performed under local anesthesia. Further studies are needed to confirm this finding and should include a prolonged observation period. These studies should be blinded and randomized, and focused on the optimal energy dosage and number of laser applications that are necessary after surgical treatment.

Eficacia clínica de láser terapéutico de bajo nivel de emisión en la reducción de dolor e inflamación posterior a cirugía periapical: Reporte preliminar.

Resumen: El objetivo del estudio fue evaluar la eficacia del láser terapéutico de bajo nivel de emisión (LTBNE) en el dolor postoperatorio e inflamación asociados con cirugía periapical. Se realizó un ensayo clínico controlado aleatorizado doble ciego en 2 grupos de 10 pacientes cada uno, que requirieron de cirugía periapical. El grupo experimental fue tratado con una aplicación intraoral de laser de GaAsAl de 810 nm, con una potencia de 100 Mw, con movimientos oscilatorios sobre la herida quirúrgica. En el grupo control, se llevó a cabo el mismo procedimiento, sin la activación del láser terapéutico. Se registraron dolor postoperatorio, inflamación y medicación de rescate. El grupo experimental mostró una disminución en la intensidad del dolor posterior a la cirugía periapical en comparación con el grupo control ($p<0.05$). No se encontró diferencia estadísticamente significativa entre los grupos en términos de inflamación. Seis pacientes del grupo control requirieron medicación de rescate. El uso de LTBNE en el manejo postoperatorio de pacientes sometidos a cirugía periapical, usando el protocolo del presente estudio redujo el dolor postoperatorio.

Palabras clave: *LTBNE, cirugía periapical, dolor, inflamación.*

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