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. Like all surgical procedures the main sequelae are pain and swelling, and both are widely studied to be minimized or controlled in this field. 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.

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. Also, it shows immune-stimulant effects and promotes cell proliferation. 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. 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. 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


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

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 or 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.](image_url)

Escalante-Macías L, Méndez-González V, Dávila-Pérez C, Chavarria-Bolaños D & Pozos-Guillén A.


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. 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).

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. 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-

Table 1. Summary of demographic and surgical variables.

<table>
<thead>
<tr>
<th>Group</th>
<th>Sample Size</th>
<th>Median Age (Range)</th>
<th>Gender (Female/ Male)</th>
<th>Teeth (Anterior/Premolars/Molars)</th>
<th>Duration of Surgery (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser</td>
<td>10</td>
<td>45 (20-55)</td>
<td>6 / 4</td>
<td>2 / 3 / 5</td>
<td>60 (40-90)</td>
</tr>
<tr>
<td>Nonlaser</td>
<td>10</td>
<td>47 (24-59)</td>
<td>5 / 5</td>
<td>1 / 4 / 5</td>
<td>60 (40-90)</td>
</tr>
<tr>
<td>p value</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td></td>
</tr>
</tbody>
</table>

* Time in minutes.

Table 2. Swelling and rescue medication.

<table>
<thead>
<tr>
<th>Group</th>
<th>Sample Size</th>
<th>Swelling Grade* 0 / 1 / 2 / 3</th>
<th>Rescue Medication YES / NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser</td>
<td>10</td>
<td>0 / 5 / 5 / 0</td>
<td>0 / 10</td>
</tr>
<tr>
<td>Nonlaser</td>
<td>10</td>
<td>0 / 3 / 7 / 0</td>
<td>6 / 4</td>
</tr>
<tr>
<td>p value</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td></td>
</tr>
</tbody>
</table>

*0 = No inflammation; 1 = Visible intraoral inflammation; 2 = Visible extraoral inflammation; 3 = Massive inflammation
fferences and absorption characteristics) make standardiza-
tion and interpretation of the results difficult.

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. In reference to the
anti-inflammatory and anti-edematous effects, laser ac-
celerates exudate resorption, decreasing liquid pressure
over the peripheral nerve endings. Some of the irradia-
tion parameters used in this study were similar to those
applied by Kreisler et al., the same type of laser (Ga-
AsAl), distance to the irradiated tissue (approximately
1 cm between fiber and tissue), number of times the ther-
apeutic 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. investigated the effect of the LLLT (810-nm), with a
power of 100 mW and an energy of 4 J/cm² in 2 groups
of 15 patients, each after removal of impacted mandi-
bular 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. evaluated the efficiency of LLLT in pain reduction
after simple third molar removal in 60 patients, 30 re-
ceiving soft laser application with a wavelength of 870
nm, energy of 4 J/cm², and power of 50 mW at a distance
of 1 cm for 10 minutes; the other 30 patients receiving
only simulated laser treatment. The patients were ins-
structed to evaluate postsurgical pain 7 days after third
molar removal using the VAS before taking any analge-
sics. The results showed that the pain level was lower in
the group receiving laser than in the control group, in-
dicating that the use of LLLT after simple third molar
removal significantly reduces postsurgical pain. When
more profound surgeries are evaluated, such as orthog-
natic surgery, LLLT shows important benefits in pain
and inflammation responses not immediately but after
24 hours. However, only few studies are conducted to
evaluate the effect of LLLT in reducing pain and swelling
after periapical surgery. Payer et al. 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/cm² after endodontic surgery. They conclud-
ed that in routine endodontic surgery cases, LLLT does
not achieve a significant clinical benefit. Kreisler et al.
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. 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 con-
troversy 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., 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 re-
cue 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

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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.

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