



# Effectiveness of low level laser in minimizing edema and promoting wound healing after third molar surgery: a randomized clinical trial

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<sup>a</sup> Craniomaxillofacial Research Center, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran; <sup>b</sup> Oral and Maxillofacial Department, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran; <sup>c</sup> Private practice.

ARTICLE INFO	ABSTRACT
<p>Article Type: <b>Original Article</b></p> <p>Received: 23 Apr 2014 Revised: 31 Mar 2014 Accepted: 10 May 2014</p> <p>*Corresponding author: Mahboube Hasheminasab Department of Oral and Maxillofacial Surgery, Craniomaxillofacial Research Center, Tehran University of Medical Sciences, Tehran, Iran</p> <p>Tel: +98 21 84902473 Fax: +98 21 84902473 Email: mahboube.hasheminasab@gmail.com</p>	<p><b>Introduction:</b> Surgical removal of third molar is one of the most common surgical procedures in oral surgery and is often associated with complications such as pain, swelling and trismus. The main purpose of the study was to assess the therapeutic effect of low level laser (LLL) irradiation on postoperative edema and wound healing compared to routine postoperative management after third molar surgery.</p> <p><b>Materials and Methods:</b> A double blinded, randomized, controlled clinical trial was conducted in 2 groups of 20 patients, each undergoing surgical removal of their impacted mandibular third molars. Postoperatively, patients in study group were irradiated with Ga-Al-As laser with a diode wavelength of 890nm and a power output of 80 mw in pulsed mode for 6 minutes intraorally. The control group received only routine post-surgical management including 400 mg Ibuprofen 4 times daily and cold packs.</p> <p><b>Results:</b> Intraoral low level laser therapy (LLLT) resulted in a statistically significant reduction in the amount of swelling on the 2nd postoperative day compared to the control group. The healing process was significantly better in laser- irradiated wounds.</p> <p><b>Conclusion:</b> The LLLT with Ga-Al-As laser seems to be safe and can be considered as an effective modality for reducing postoperative discomfort and promoting wound healing after third molar surgery.</p> <p><b>Keywords:</b> Third molar, Low level laser, Edema, Wound healing.</p>

## Introduction

Since the introduction of laser in 1960 by Theodor Maiman, there has been rapid development in its application in medical fields. In 1971, Mester and his colleagues used laser therapy to accelerate the healing of chronic wounds and obtained promising results [1]. Since then, laser therapy has been applied to treat a variety of disorders including rheumatoid arthritis, osteoarthritis, tendinopathies and non-healing ulcers, among others [2].

In oral and maxillofacial surgery, promising results have been reported in the application of lasers in treatment of temporomandibular joint disorder, inferior

alveolar nerve paresthesia following third molar surgery, trigeminal neuralgia, bisphosphonate related osteonecrosis of jaws, alveolitis, aphthous ulcers and chronic wounds [3]. The first publications about Low Level Laser Therapy (LLLT, also called laser bio-stimulation) appeared more than 30 years ago. In animal models, it has been shown that laser therapy can promote osteoblastic activity and bone regeneration [4]. *In vitro* studies demonstrated that LLL irradiation increases the fibroblastic proliferation and their transformation into myofibroblasts [5,6].

In addition, both visible light and infrared LLLT have been shown to act on immune system cells in a number of ways, including

activating the irradiated cells to a higher level of activity, increasing phagocytic and chemotactic activity of human leukocytes [7]. In other studies, it has been demonstrated that LLLT can increase the mobility of human epidermal keratinocytes, promote the proliferation, differentiation and calcification of osteoblastic cells as well as decreasing the isometric tension in the vascular smooth muscles [8].

Surgical removal of third molar is one of the most common surgical procedures in oral surgery and is often associated with complications such as pain, swelling and trismus. These complications reduce patient's quality of life significantly.

Since in previous studies it has been shown that beside its anti-inflammatory effect, LLL can promote wound healing, it was decided to perform this study to evaluate the therapeutic effects of LLL on reduction of postoperative edema and its effect on wound healing [1,2].

### Materials and Methods

This investigation was a double-blinded randomized controlled clinical trial conducted on patients referred to Oral and Maxillofacial Surgery Department of Tehran University of Medical Sciences for surgical removal of their impacted mandibular third molars. All subjects were informed of the whole procedure and its potential risks and informed consent was obtained from all participants. The ethics committee of Tehran University of Medical Sciences approved the study design.

Forty healthy adults were recruited to this study. Inclusion criterion was the presence of mesioangular impacted mandibular third molars that were fairly similar in terms of degree of impaction and their estimated difficulty of removal. Exclusion criteria included: 1) the presence of any systemic conditions that would contraindicate oral surgery procedures; 2) presence of pericoronitis or any other inflammatory or pathologic lesions in the area of impacted teeth; and 3) taking any kind of medications including analgesics, sedatives, antibiotics or steroids at least 15 days prior to the surgery.

### Surgical procedure

All surgical procedures were carried out by the same qualified surgeon. Teeth were extracted under local anesthesia with 2% Lidocaine and

1:100,000 Epinephrine. Three cartridges were injected for each patient. Full thickness triangular mucoperiosteal flaps up to the mesiobuccal line angle of second molar were raised to gain access to the impacted teeth. Bone removal and tooth sectioning were performed with carbide burs under constant irrigation with normal saline solution. Surgical sites were irrigated with the same amount of normal saline on each patient. After obtaining hemostasis, wound closure was achieved with equal numbers of sutures using 3-0 black braided silk to reposition the flaps to their original positions. All surgical procedures lasted less than 30 minutes.

Patients were randomly allocated to 2 treatment groups. Within 10 minutes following surgery, the members of study group received laser therapy. Laser was applied intraorally through a handpiece (LO2 probe) placed on the lingual surface of the surgical site in intimate contact with mucosa for 6 minutes (Figure 1). A therapeutic Gallium, Aluminum, Arsenide infrared (Ga-Al-As) laser (Mustag, Russia) (Figure 2) with an 890nm wave length diode and a power output of 80 mw in pulsed mode was applied. Postoperatively, patients in



Figure 1. Intraoral laser application.



Figure 2. Gallium, Aluminum, Arsenide infrared (Ga-Al-As) laser (Mustag, Russia) device.

**Table 1.** Average swelling (mm) at different time intervals (n= 20 in each group)

day	Study group	Control group
2	1.87±0.75	2.38±0.81
7	0.28±0.34	0.75±0.55

the study group were administrated 500mg Acetaminophen every 6 hours for 3 days.

In order to achieve the placebo effect and to blind the control group, they underwent a simulated postoperative procedure. The handpiece was inserted intraorally for 6 minutes but the laser was not activated. Patients in control group were provided with the routine postoperative management including cold compress over the skin of the surgical site for 20 minutes intermittently for 8 hours. They were prescribed 400mg Ibuprofen 4 times daily for 3 days. All patients were administrated 500mg Amoxicillin 3 times daily for 5 days and were instructed to rinse their mouth with 0.2% Chlorhexidine mouthwash twice daily for a week. They were also advised to avoid any medications except those prescribed.

### Postoperative evaluations

In order to objectively evaluate the swelling at the surgical site, two distances were measured: from the tip of tragus to oral commissure and to soft tissue pogonion. The measurements were made before the operations and again 2 and 7 days after surgery, using a flexible and non-extensible scale. The average values for these 2 measurements were calculated and subtracted from the preoperative values and considered as the amount of facial swelling. All the measurements were performed by 2 operators and the average values were used for statistical analysis.

To assess the degree of wound healing, the releasing incisions of the flaps were meticulously examined by two oral surgeons 7 days after surgery. In case of any dehiscence, tissue sagging or floppiness, the surgical wound was considered “poorly healed”.

### Statistical analysis

To statistically analyze the postoperative edema, we used analysis of variance (repeated measure ANOVA) and chi-square analysis was carried out to compare the degree of wound healing between the 2 groups.

### Results

Forty healthy individuals consisting of 20 males and 20 females between 18 and 30 years of age were recruited to our study and underwent surgical extraction of their impacted mandibular 3<sup>rd</sup> molars unilaterally.

The amount of swelling experienced on the 2<sup>nd</sup> day after surgery was significantly less in laser-receiving group compared to the control group. The mean amount of swelling on the 2<sup>nd</sup> postoperative day were 2.38±0.81 and 1.87±0.75 mm for the control and study groups, respectively (p=0.02). Meanwhile, there was no statistically significant difference between the amount of swelling in 2 groups on the 7<sup>th</sup> postoperative day, with the average amount of 0.28±0.34 and 0.75±0.55 mm for the study and control groups, respectively (p=0.82) (Table 1).

Post-surgical wound healing was significantly better on the experimental group. In laser-receiving patients, 75% of surgical wounds were considered well-healed compared to 40% in the patients in control group (p=0.03).

None of the patients developed post-operative infection and/or alveolar osteitis. No adverse reaction due to laser therapy was observed in any patient.

### Discussion

Post-operative edema is a consequence of tissue injury during surgery and is often considered as the most common complication following surgical removal of third molars. Several methods have been used to reduce the amount of postoperative edema including medications and physical procedures (enzymes, steroids, cold packs, etc.). Among these treatment modalities, perioperative application of LLLT has recently attracted clinician's attentions. In our investigation, we found that LLLT with Ga-Al-As laser can significantly reduce the amount of edema on the second day following surgery, when edema tends to reach its peak, compared to routine postoperative recommendation including the administration of Ibuprofen and cold compress.

The result of our study is consistent with the findings of the study performed by Honumura et al which demonstrated that the application of Ga-Al-As laser with a certain protocol reduced the amount of induced edema in rats [9]. This anti edematous effect of LLLT could be primarily due to the inhibitory effect of laser irradiation on the increase in vascular permeability during the occurrence of an acute inflammation. Furthermore it is believed that laser irradiation induces an increase in number and diameter of lymph vessels while simultaneously decreases the vessel permeability [10].

On the 7<sup>th</sup> postoperative day, we found no significant difference between the amounts of edema experienced by the experimental and control groups. This was quite expected since normally physiologic processes eliminate post-surgical edema and inflammation within a week.

Additionally, in our study we found that the healing process was significantly better both statistically and clinically in laser receiving group. The positive effect of LLLT in acceleration of wound healing could be attributed to multiple factors including :1) increasing the formation of granulation tissue, 2) increasing fibroblast proliferation, maturation and matrix synthesis, 3) promoting neovascularization, and 4) reducing synthesis of inflammatory mediators, etc [11].

Various previous studies have resulted in controversial findings regarding the effectiveness of LLLT in reducing post-operative complications of third molar surgery. Amarillas-Escobar et al demonstrated that intraoral and extraoral application of therapeutic laser decreases post-operative pain, swelling and trismus without statistically significant difference compared to standard management [12]. In their study, both experimental and control groups received a single dose of intramuscular Dexamethasone preoperatively and 500 mg Acetaminophen 4 times a day administrated for 3 days postoperatively. Markovic et al showed that the LLL irradiation significantly reduced postoperative pain intensity in patients premedicated with a single dose of Diclofenac compared to the control group [13]. In a different study, Markovic et al demonstrated that LPL irradiation with local injection of 4mg Dexamethasone in internal pterygoid muscle resulted in a statistically significant

reduction of postoperative edema in comparison to other groups who received LLLT or systemic Dexamethasone separately or the control group who received the usual postsurgical recommendations (cold packs, soft diet) without any additional treatment [14]. These studies were similar to ours in term of objective, however the advantage of our study was that we solely applied laser intraorally and used no other anti-inflammatory agents in the study group to evaluate the pure therapeutic effect of intraoral LLLT. We also provided the effect of LLLT on wound healing.

On the other hands, numerous studies have demonstrated no meaningful difference in postoperative sequelae and wound healing between the laser receiving and control groups [15]. These controversial results could be simply attributed to differences in methodological, biological and physical variables such as types of applied laser, output power (continuous or pulsed), wavelength, time and mode of application, distance of source to irradiated tissue as well as histologic tissue differences and absorption characteristics.

Although much more research needs to be performed, it could be concluded that LLLT with Ga-Al-As laser using the recommended protocol could be safely applied for management of postoperative edema and to promote wound healing after third molar surgery.

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**Conflict of interest:** *The authors declared no conflict of interests.*

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