

# Low Level LASER Effectiveness in Reducing Complications Associated with Surgical Removal of Impacted Lower Third Molars: Systematic Review

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**Abstract:** ***Background:** The use of Low-Level Laser therapy in health care has been documented in the literature for more than three decades and it has been shown to exert reliable effects on the acceleration of the wound healing process. **Aim of the Study:** This study aimed to review the therapeutic laser's effectiveness in controlling pain and swelling associated with surgical removal of impacted third molars. **Material and Methods. Materials and Methods:** A MEDLINE (PubMed) search was conducted for the randomized controlled trials in the dental literature from 2016 up to 2021 and limited to human trials. The following keywords were used in the search: low level laser therapy after surgical extraction of lower third molar. **Results:** The total results of electronic search were (28) abstract and articles. Of the (28) articles, (20) articles were excluded, and only (8) which fit the inclusion criteria were involved in this research. **Conclusion:** Using intra-oral LLLT is useful in decreasing the intensity of pain and swelling after removal of impacted third molars.*

**Keywords:** low level laser therapy after surgical extraction of lower third molar

## 1. Introduction

Surgical removal of mandibular third molars (SRM3) is a common dental surgical intervention. (Coulthard et al., 2014). Approximately 90% of patients undergoing impacted third molar removal will report moderate or severe pain. (Seymour et al., 1983) The duration of the surgical procedure has been reported to be positively associated with the severity of postoperative pain (Curtis et al., 1985) However, Dentists have traditionally relied on steroids, nonsteroidal antiinflammatory drugs, and narcotic analgesics to manage surgery's postoperative sequelae. Later on, after studying and understanding the biological effects of Light Amplification by the Stimulated Emission of Radiation (LASER) (Inyushin et al., 1967). There was increased use of LASER in the treatment of a wide variety of disorders, including carpal tunnel syndrome, rheumatoid arthritis, osteoarthritis, tendinopathy, ankle sprains, epicondylitis, and non-healing ulcers (Miloro et al., 2011-Silveira et al., 2011). Although the exact mechanism of analgesic and anti-inflammatory effects produced by LLLT are not yet fully known; evidence suggests that LLLT has significant neuro-pharmaceutical effects on the synthesis, release, and metabolism of biochemical material. The mechanism of LLLT is complex. Introduction 2 In general, the anti-inflammatory effect of laser-based on reducing the accumulation of Prostaglandin E2 (PGE2), inhibiting the effects of Interleukin-6 (IL-6), Interleukin-10(IL-10), monocyte chemotactic proteins 2(MCP-2), and Tumor necrosis factor-alpha (TNF- $\alpha$ ) in the acute inflammatory phase. Furthermore, this effect strengthened with the help of change in the permeability and channel size of lymph and blood vessels. (López-Ramírez et al., 2012- Eshghpour et al., 2016) LLLT has been used for the prevention of swelling and trismus after the removal of impacted third molars, following periodontal surgery procedures, for reducing orthodontic post adjustment pain, as well as for the treatment of chronic facial pain, chronic sinusitis, gingivitis, herpes simplex, dentinal tooth hypersensitivity, and sensory aberrations in the inferior alveolar nerve. (Aras et al., 2009-Ficácková et al., 2007) Although LLLT has been used to

prevent postoperative swelling and trismus after third molar surgery, the results are controversial. This might be due to varying study designs, differentiation, or difficulties in the measurement of variables related to postoperative sequelae, different lasers & hand piece types, and different irradiation parameters. (Ozen et al., 2006- Amarillas-Escobar et al., 2010)

### Aim of the Study

This study aimed to review the therapeutic laser's effectiveness in controlling pain and swelling associated with surgical removal of impacted third molars.

## 2. Materials and Methods

Search strategy and study selection : A MEDLINE (PubMed) search was conducted for the randomized controlled trials in the dental literature from 2016 up to 2021 and limited to human trials. The following keywords were used in the search: low level laser therapy after surgical extraction of lower third molar.

### Inclusion criteria:

This systematic review included RCT (randomized controlled trials) and clinical studies. The additional inclusion criteria for study selection were: 1. Publications in the dental literature, based on human subjects. 2. Studies in the English language only. 3. Healthy patient with no systemic disease That may affect wound healing.

### Exclusion criteria:

1. Case reports, reviews, case series with less than 10 patients. 2. Studies published in another language than English. 3. Experimental studies (animals). 4. Patient with systemic disease that may affect the results.

## 3. Results

The total results of the electronic search were (28) abstract and articles. Of the (28) articles, (20) articles were excluded, and only (8) which fit the inclusion criteria were involved in

this research. The characteristics data and results for each included article are summarized in Table (1). Twenty articles were excluded from this research because of the following points: 1- Nine articles were excluded because it wasn't a

randomized controlled trial study. 2- Ten articles were excluded because it wasn't done during the study period. 3- One article was excluded because it wasn't clinical study.

**Table 1: Summary of the characteristics and results of the selected articles**

First author/ Year of publication/ Study design	Study Population characteristics	Parameters	Measurement methods	Conclusions
<b>F Asutay et al. 2018 RCT</b>	45 healthy patients <b>Group 1</b> , the control group, received only routine management (ice application); <b>Group 2</b> , laser group, received single-dose LLLT immediately after surgery; <b>Group 3</b> , sham group (negative control group), received sham LLLT immediately after surgery.	Swelling, pain, trismus.	<b>Swelling:</b> assessed by 3D surface imaging device (3dMD Photogrammetric System). <b>Pain:</b> visual analog scale VAS ranging from 0 to 10 <b>Trismus:</b> was recorded by measurement of the maximal distance between the inter-incisor opening using manual calipers before the surgical procedure and 2nd and 7th days post extraction.	LLLT reduced the intensity of pain following third molar surgery by single dose. The results of this study revealed that LLLT reduced facial swelling, but no significant differences were found among the three groups.
<b>Pâmela Letícia Santos et al. 2020 RCT Double-blinded Split-mouth</b>	32 patients patients who required <b>bilateral extraction</b> of unerupted lower third molars. Patients received LLLT on one side ( <b>laser group</b> ) but not on the opposite side ( <b>control group</b> ). On the experimental side, each patient received a laser application at 5 intraoral points for 30 seconds per point.	Pain	Pain assessed with a modified <b>pain visual analog scale at the following times:</b> immediately after surgery (T0), after laser application (T1), 24 hours after surgery (T2), 48 hours after surgery (T3), and 72 hours after surgery (T4).	LLLT was effective in reducing pain after surgical removal of unerupted third molars. At T3 and T4, pain reduction in relation to T0 was noted in both groups.
<b>Majid Eshghpour et al. 2016 RCT Double-blinded Split-mouth</b>	40 patients patients presenting 2 symmetrically impacted mandibular third molars. In each participant, one side was randomly assigned to laser treatment and the other side received placebo.	Pain, Swelling.	<b>Pain:</b> (VAS) <b>Facial swelling:</b> the distance between the tragus and lip commissure and the distance between the gonion and external canthus of the eye, were measured before surgery (baseline) and after 2, 4 and 7 days of operation.	LLLT proved effective in decreasing the intensity of pain and swelling after removal of impacted third molars and can be recommended to alleviate patients' symptoms after surgery.
<b>Sevil Altundag Kahraman et al. 2017 RCT placebo controlled, single-blind, split-mouth</b>	60 patients patients with full bony impacted similar position mandibular third molars bilaterally The patients were divided into <b>two groups</b> of 30 each: <b>transcutaneous LLLT</b> and <b>intraoral LLLT</b> and the other side of each group treated with nonactive laser (60 teeth)	Pain	Postoperative pain was measured using a visual linear ranking scale (1-10cm)	The results of this study suggest that single-session intraoral LLLT is more effective than extraoral application for reducing postoperative pain. It was postulated that the differences between skin and mucosa could have effect on the results.
<b>Carlos Alberto Tenis et al. 2018 RCT Double-blind, Placebo-controlled clinical trial</b>	38 adult participants participants will be randomized into 2 groups. <b>Research group:</b> the LED group, participants will receive LED applications (intra oral with 660 nm, 12J and extraoral with 850 nm, 108J) in the immediate postoperative, first and second days after the surgical procedure. <b>control group:</b> the participants will be attended in the same way as in the LED group, however, the person in charge of the application will simulate the irradiation.	Pain Edema Muscle spasm	postoperative <b>pain</b> evaluated by visual analog scale (VAS) and NRS-101 scale.  Postoperative edema was measured the distance between the corner of the eye and angle of the mandible, between tragus and labial commissure and between tragus and pogonium of each patient 1,2,5 and 7 days after surgery.  Postoperative <b>muscle spasm</b> was measured the distance between the incisal edges of the upper and lower central incisors, using a caliper rule.	The use of low-power laser in the postoperative has shown good results in the control of postoperative sequelae, this is the first study on the efficacy of the use of LED in this situation.

<p><b>Sampaio-Filho H.</b></p> <p><b>2018</b></p> <p><b>RCT</b></p> <p><b>single-blinded study</b></p>	<p>42 healthy patients with Eighty-four bilateral, symmetrical third molar surgeries were performed in using a split-mouth design. In the immediate postoperative period, each side was randomly treated in a single-blind method with an LLL at the auriculotherapy points or simulation of its use (contralateral side) over a 21-day interval. This protocol was repeated 24 and 48 hours after surgery. All patients used the same analgesic (paracetamol) but only in case of pain.</p>	<p>Pain, mouth opening, edema,</p>	<p>Postoperative pain was assessed by applying the visual analog scale (VAS)</p> <p>mouth opening evaluation based on the inter-incisal measurement in millimeters was measured with a digital caliper</p> <p>Edema measurements were based on 3 measures: I) Eye Corner, up to the angle of the jaw; (II) Tragus to commissure lip; and (III) Tragus to Pogona's.</p>	<p>low-intensity laser treatment at auriculotherapy points did not prevent postoperative pain in lower third molar surgeries.</p>
<p><b>Feslihan E.</b></p> <p><b>2019</b></p> <p><b>RCT</b></p> <p><b>single-blind study</b></p>	<p>30 healthy patients with bilaterally impacted lower third molars. The time interval between two surgical operations was at least 3 weeks. In the <b>laser group</b>, Laser applied extra orally to the insertion point of the masseter muscle then repeated on postoperative days 1 and 2. In the <b>corticosteroid group</b>, 40 mg/2 mL methylprednisolone sodium succinate was injected postoperatively into the masseter muscle with the intrabuccal approach. On postoperative day 1, methylprednisolone injection (20 mg/1 mL) was repeated.</p>	<p>pain, swelling, and trismus</p>	<p>The postoperative intensity of pain was evaluated using the visual analog scale (VAS). Postoperative edema was evaluated based on the facial distance that was determined by measuring the distances between some anatomical points on the face.</p> <p>The postoperative trismus was evaluated according to the maximum mouth opening that was determined by measuring the interincisal distance between the maxillary and mandibular incisor teeth using a digital caliper</p>	<p>laser could be considered a useful and feasible method to prevent postoperative complications associated with impacted third molar surgery as it showed similar effects to that obtained by methylprednisolone, the clinical efficacy of which has been proven. Particularly, taking the side effects of NSAIDs and corticosteroids into consideration.</p>
<p><b>Momeni H. et al.</b></p> <p><b>2021</b></p> <p><b>RCT</b></p> <p><b>double-blind study</b></p>	<p>25 healthy subjects</p> <p>The intraoral Laser diode 940 nm was applied immediately after suture on the tested side, while on the placebo side, a fiber tip was used with no laser radiation following surgery.</p> <p>After the surgery, amoxicillin 500 mg was prescribed every 8 h for a 7-day period besides oral Ibuprofen (Gelofen) 400 mg every 12 h for a 3-day period. r</p>	<p>pain, swelling, and trismus</p>	<p>The pain score was evaluated by visual analogue scale VAS</p> <p>The extent of mouth opening was evaluated by measuring the maximum distance between the central teeth of the mandible and maxilla using a caliper</p> <p>The extent of swelling was also evaluated by measures the distance between the chin and tragus of the ear.</p>	<p>The results suggest that although the pain, swelling, and trismus following surgery were lower on the radiated side, only pain was found to be significantly reduced on the radiated side.</p>

#### 4. Discussion

Impacted tooth extraction provides a suitable surgical field that enables the evaluation of the performance of many anti-inflammatory medications/ applications in terms of tissue response and postoperative complications. (Feslihan E. 2019)

In the last few decades, there has been a growing interest in investigating the physiological effects of LLLT and its various clinical applications in different medical and dental specialties. Since the LLLT can accelerate the regeneration of lymph vessels, decrease vascular permeability, and reduce hemorrhage, neutrophil infiltration, inflammatory cytokines, and enzymes, it may have a positive effect on postoperative morbidities of third molar surgery.

Many studies exist regarding the effect of LLLT on the morbidities of third molar surgery and have reported conflicting results.

Majid Eshghpour *et al.* (2016) found that extra-oral application of LLLT is effective in decreasing the intensity of pain and swelling after removal of impacted third molars.

While Sevil Altundag Kahraman *et al.* (2017) shows that single-session intraoral LLLT is more effective than extraoral application for reducing postoperative pain.

These results of the intra-oral application of the LLLT may be explained if we realize that Penetration of diode laser primarily depends on the optical properties of the skin or oral mucosa, which in turn depend on the type and thickness of the epithelium, reflectance, melanin content, and level of vascularization of the submucosa. This ability is related to both the penetrating ability of the diode laser and the

distance to the pathologic processes that are to be influenced. The interaction is photochemical in nature & is dependent on absorption by a tissue chromophore. The absorption likely increases the energy of this chromophore; therefore, its activity is altered with its environment. Consequently, the metabolism of the cell is changed, affecting tissues and organs.

On the other hand, **Sampaio-Filho H. (2018)** found low-intensity laser treatment at auriculotherapy points did not prevent postoperative pain in lower third molar surgeries. And this can be attributed to the subjective method used in measuring pain.

Another study by **Momeni H. et al. (2021)** shows that the pain, swelling, and trismus following surgery were lower on the radiated side, only pain was found to be significantly reduced on the radiated side.

These conflicting results may be due to difficulties in the measurement of variables related to postoperative sequelae, differences in study design or methods, differences in types of lasers and handpieces used, and differences in irradiation parameters.

## 5. Conclusion

Using intra-oral LLLT is useful in decreasing the intensity of pain and swelling after removal of impacted third molars

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