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The effect of preoperative low-level laser therapy on pain, swelling, and trismus associated with mandibular third molar extraction

Sabina Karşıcı[1] and Emre Balaban[2*]

Abstract

Objective This study aimed to evaluate the effect of low-level laser therapy (LLLT) applied before mandibular third molar extractions on postoperative pain, swelling, and trismus.

Materials and methods The study included 28 patients aged 18–45 years with bilaterally impacted mandibular third molars in similar positions, indicated for extraction based on clinical and radiographic examinations. Patients were divided into two groups: Group 1 received LLLT 10 min before surgery, while Group 2 (control group) underwent routine impacted tooth extraction after applying blue LED light. Measurements were taken preoperatively and at 24 h (T0), 48 h (T1), and 7 days (T2) postoperatively to assess the effects of LLLT on pain, swelling, and trismus. Statistical analysis was performed using the Jamovi 2.2.5 software. Due to the non-normal data distribution, the Friedman test was used for repeated measures within groups, while the Mann-Whitney U test was employed to compare the laser and control groups.

Results The study included 23 female (82.14%) and 5 male (17.86%) patients, with a mean age of 21.34 ± 4.37 years. No statistically significant differences were observed between the laser and control groups concerning pain, trismus, and swelling at T0, T1, and T2 ($p > 0.05$).

Conclusion Within the limitations of this study, preoperative LLLT showed clinically acceptable effects on postoperative pain, swelling, and trismus. Further clinical studies are needed to evaluate the long-term success of LLLT.

Keywords Impacted tooth, Laser, LLLT, Pain, Swelling, Third molar, Trismus

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Introduction

It is well known that the impaction of teeth can be a problem that negatively affects individuals' quality of life [1]. Among all teeth, mandibular third molars (MTMs) have the highest impaction rate [1]. The extraction of MTMs is one of the most frequently performed surgical procedures in dentistry due to the problems they commonly cause or are likely to cause. Chronic pericoronitis, idiopathic facial pain, caries in adjacent teeth, prosthetic, periodontal, and orthodontic reasons, and pathologies such as cysts and tumours, are the most common indications for MTM extraction [2, 3]. While the extraction of impacted MTMs that have caused infections or other pathologies is recommended, the prophylactic extraction of asymptomatic impacted MTMs remains a topic of debate [1].

The guidelines of the National Institute for Health and Care Excellence (NICE) do not recommend the prophylactic extraction of mandibular third molars (MTMs) [4]. Kandasamy et al. [5] note that despite the extensive literature on MTM extraction, "there is significant individual variability and numerous practitioner beliefs and biases, particularly regarding the extraction of asymptomatic and pathology-free third molars, with evidence-based decision-making being prioritized."

The ambiguity surrounding the extraction of asymptomatic or pathology-free MTMs arises from the inconsistent and misleading use of terminology [6, 7]. In some studies, "asymptomatic" refers to the absence of pathology associated with the teeth, while in others, it denotes the absence of symptoms [7]. There is a critical distinction between being disease-free and asymptomatic, as the latter does not necessarily imply the former. It has been suggested that pathology always precedes symptoms; therefore, it would be prudent for clinicians to assume the development of pathology if the teeth become symptomatic [6].

The terminology used in clinical research must clearly define the condition being described (e.g., the presence or absence of pathology); otherwise, inconsistent findings will inevitably be reported.

The development of pain, swelling, and trismus following the extraction of impacted MTMs results from the inflammatory response associated with surgical trauma [8]. Additionally, various complications may arise post-surgery, including alveolitis, paraesthesia, infection, prolonged bleeding, and temporomandibular joint (TMJ) pain [9].

In MTM surgery, factors such as the patient's gender, age, systemic health, presence of pericoronitis, oral hygiene status, smoking, use of contraceptive pills, and the degree of impaction difficulty significantly influence the development of complications [10]. Additionally, several practitioner-related factors, including the surgical technique, duration of the procedure, socket irrigation, and anaesthesia methods, may also play a role in the occurrence of complications [10–12].

To reduce inflammation and pain following impacted MTM surgery, the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and local or systemic corticosteroids has been recommended. However, these medications may cause side effects such as gastrointestinal issues, systemic bleeding, and allergic reactions [13]. Additional methods could be considered to minimise postoperative complications and support the healing of mucosal wounds.

Low-level laser therapy (LLLT) is increasingly being used to reduce postoperative complications following various surgical procedures in the oral cavity, as it accelerates tissue regeneration and wound healing while reducing pain and swelling through anti-inflammatory mechanisms [14]. It is known that laser therapy not only accelerates cell and tissue reconstruction but also alleviates postoperative pain [13]. Researchers have reported that laser therapy has analgesic, anti-inflammatory, and biostimulator effects; enhances tissue nutrition and connective tissue elasticity; reduces swelling; promotes lymphatic drainage; and increases synovial membrane regeneration [15]. Specifically, LLLT can modulate the inflammatory process by reducing pain and swelling and accelerating the repair of damaged tissues [16].

LLLT has significant and rapid effects in reducing levels of pain and inflammation mediators such as prostaglandin E2 (PGE2), interleukin 1 (IL-1), tumour necrosis factor (TNF), and cyclooxygenase-2 (COX-2) [13].

This study aims to evaluate the effects of preoperative LLLT on pain, swelling, and trismus in patients undergoing mandibular third molar extraction.

Materials and methods

Informed consent was obtained from all patients. This double-blind, controlled, randomized clinical trial was approved by the Clinical Research Ethics Committee of the Faculty of Medicine, Recep Tayyip Erdoğan University, with the decision dated 20.07.2022 (2022/05) and by the Turkish Ministry of Health, Medical Device and Drug Authority, with approval number 68869993-511.06-835580.

This study was conducted on a total of 28 patients, consisting of 23 women (82.14%) and 5 men (17.86%), all of whom had bilaterally impacted mandibular third molars indicated for extraction based on clinical and radiological examinations at the Faculty of Dentistry, Recep Tayyip Erdoğan University, in 2022.

Formation of study groups

Based on the power analysis conducted (95% confidence level (1-α), 95% test power (1-β), d = 0.717 effect size), the required sample size for the study was determined to be

28 patients. In our study, patients scheduled for bilateral impacted lower third molar surgery were included in both the study and control groups. The 28 patients were divided into two groups: Group 1 received low-level laser therapy (LLLT) 10 min before the surgical operation, while Group 2, the control group, underwent routine impacted tooth extraction following the application of blue LED light.

Before the procedure and after surgery, swelling and trismus were assessed by measuring certain anatomical points on the face to determine facial distance and maximum mouth opening. Additionally, pain was evaluated using the Visual Analog Scale (VAS). Measurements were taken preoperatively (T0), on the 2nd day (T1), and the 7th day (T2), and statistical analysis was performed to evaluate the differences between these time points.

Inclusion criteria

Healthy patients aged 18–45 years without systemic diseases were included in the study. The participants had impacted lower third molars with vertical and mesioangular positions (classified as class 2 and class B according to Pell and Gregory classification, and mesioangular according to Winters classification) and similar levels of bone retention. After obtaining medical and dental histories from the patients, radiological and oral examinations were conducted using routine orthopantomograms.

Exclusion criteria

- Patients with systemic diseases that interfere with surgery or wound healing,
- Patients who have been using anti-inflammatory drugs (NSAIDs) for an extended period,
- Patients undergoing steroid or antihistamine treatment, or those with allergies to any of the medications used in the study,
- Active smokers,
- Patients with acute infections in the oral or extraoral regions,
- Pregnant or breastfeeding patients,
- Patients for whom laser therapy is contraindicated,
- Patients unable to attend follow-up examinations were excluded from the study.

Low-level laser therapy (LLLT) application

All participants were first informed about the risks of the procedure and treatment, and their consent was obtained after they read and signed the informed consent form approved by the ethics committee. Before the surgical procedure, randomization was used to determine which side of the patient's mouth would receive LLLT. Measurements necessary for assessing preoperative swelling and trismus were performed and recorded in the case report form.

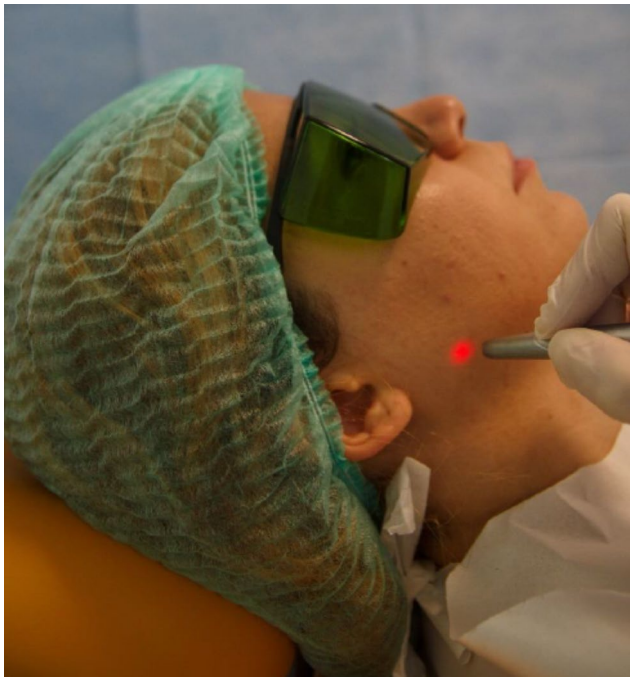

Fig. 1 Extraoral LLLT (Low-level laser therapy) application

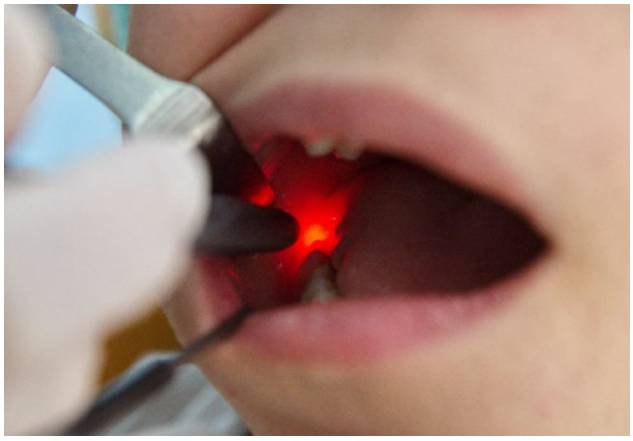

Fig. 2 Intraoral LLLT (Low-level laser therapy) application

LLLT was applied using a diode laser (Indium Gallium Arsenide Phosphor (InGaAsP), Biolase Epic, wavelength 940 ± 10 nm, power output 0.1 W, 35 J/cm^2 continuous mode, fibre tip diameter 300 µm, frequency 50/60 Hz) in continuous mode, with a biostimulation head having a spot size of 1 × 3 cm. Each patient's LLLT session consisted of one extraoral (Fig. 1) and one intraoral (Fig. 2) phase. Specifically, the laser was applied extraoral for 60 s over the masseter area at 1 cm from the skin and intraorally for 60 s on the buccal side of the alveolus of the teeth to be extracted and for 60 s on the lingual side. The laser was used in circular motions, maintaining a

constant distance of 1 cm from the masseter region and the gingiva.

Surgical procedure

The surgeries were performed with a minimum interval of 3 weeks between the two extractions. After LLLT application, before the extraction of the impacted third molars, all patients received an inferior alveolar nerve block and a buccal nerve block using a solution containing 80 mg of articaine hydrochloride and 0.020 mg of epinephrine, equivalent to 0.03638 mg of epinephrine bitartrate (MAXICAINE FORT VEM Pharmaceuticals, Çankaya/ANKARA).

Once anaesthesia was achieved, a horizontal and buccal relaxing incision was made with a #15 scalpel and a full thickness mucoperiosteal flap was raised. Buccal bone removal and, if necessary, tooth sectioning were performed using a surgical micromotor and tungsten carbide or steel round burs under saline irrigation. After the bone around the impacted tooth on both the right and left sides was removed, a cleavage point was created between the tooth and cortical bone in the mesial and buccal regions, and the tooth was removed from the alveolar socket using a bone elevator. After tooth extraction, any debris, bone, and epithelial remnants in the alveolar socket were removed. The socket was irrigated with 0.9% NaCl isotonic saline solution, and the wound edges were primarily closed using 3/0, 18 mm, 75 cm 3/8 cutting needle silk sutures, ensuring haemostasis.

To minimize differences between the skills of different surgeons, a single surgeon performed all surgical procedures. To prevent potential bias in the study results, a randomized double-blind design was chosen, with the assessment and evaluation of the groups being performed by an individual who was unaware of the group allocation. After the surgical procedure, postoperative care instructions were provided to the patients, and detailed written forms containing these instructions were given to them.

Postoperative prescription and recommendations

To assess the effect of laser treatment on facial swelling, all patients were advised not to apply ice on the side where the laser treatment was applied after the surgery. All patients have prescribed the following medications for postoperative use over one week: 875 mg amoxicillin + 125 mg clavulanic acid (AUGMENTIN, GlaxoSmithKline Pharmaceuticals, Istanbul), to be taken twice daily at 12-hour intervals, 500 mg paracetamol (PAROL, Atabay Chemical Industry and Trade, Istanbul), twice daily, 120 mg (0.12%) chlorhexidine gluconate + 150 mg (0.15%) benzydamine hydrochloride (KLOROBEN, Drogsan Pharmaceuticals, Ankara), to be used three times daily from the first day post-surgery until the removal of stitches (7 days).

On the 2nd and 7th postoperative days, the necessary measurements for evaluating pain, swelling, and trismus were repeated, and the differences were analyzed. Measurements were taken before and after the surgery to assess pain, swelling, and trismus, and data were collected for statistical analysis by dividing the patients into two groups.

Evaluation of postoperative complications

Visual analog scale (VAS) pain assessment

The Visual Analog Scale (VAS) is a tool used to quantify subjective values that cannot be measured numerically. A 10 cm scale is used, with the two endpoints labelled to define the extremes of the parameter being evaluated. The patient is asked to mark a point on the scale that represents their pain intensity. To assess postoperative pain intensity, a 10 cm Visual Analog Scale (VAS) ranging from 0 (no pain or discomfort) to 10 (maximum pain or discomfort) was used. After explaining how to use the scale, the patient marked their pain level on the scale, with evaluations performed on the 2nd (T1) and 7th (T2) postoperative days.

Evaluation of swelling

To evaluate the postoperative swelling, the facial distance was calculated by measuring the distances between certain anatomical reference points (Tragus-Labial Commissure, Gonion-Lateral Cantus, and Gonion-Labial Commissure) before and after surgery. These measurements were then summed and divided by three to obtain the facial distance (Fig. 3). The facial distances for the right and left sides of the patient were calculated separately. The distances between the points were measured using a tape measure.

Measurements were taken immediately before the surgery (T0) and on the 2nd (T1) and 7th (T2) postoperative days. The postoperative swelling was expressed as the percentage increase in the width of the face. The preoperative measurements served as reference points for determining the cheek swelling percentage on the first and seventh days after surgery.

Evaluation of trismus

To assess postoperative trismus, the distance between the incisal edges of the maxillary and mandibular central incisors was measured using a scalpel handle before surgery (T0), and on the 2nd (T1) and 7th (T2) postoperative days. The maximum mouth opening was recorded (Fig. 4).

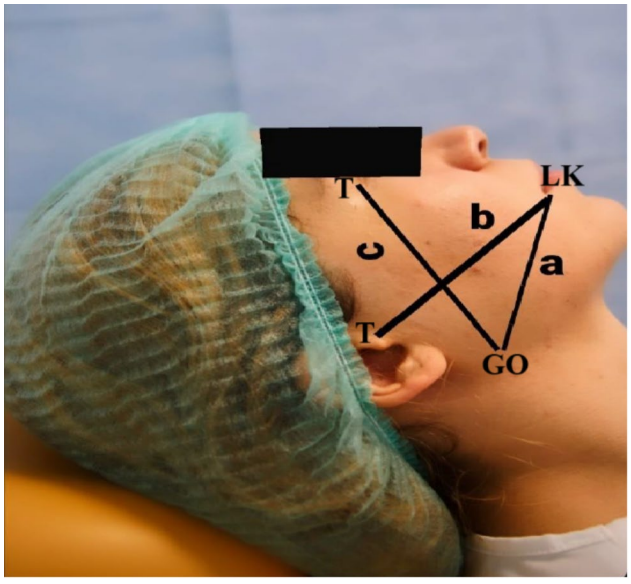

Fig. 3 Anatomical reference points used in face distance measurements
T: Tragus
LK: Labial Commissure
K: Canthus
GO: Gonion
(**a**) GO - LK (**b**) T - LK (**c**) GO - K

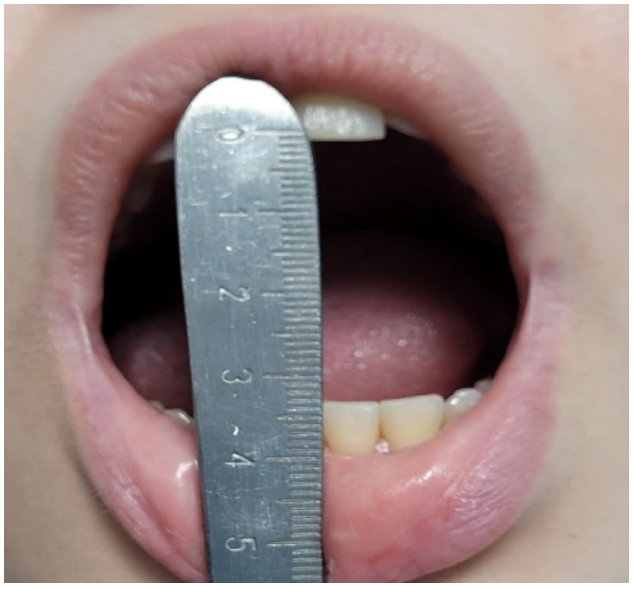

Fig. 4 Measurement of the interincisal distance

Statistical analysis

The statistical analysis was performed using Jamovi 2.2.5 software. The normality of the distributions was assessed using the Shapiro-Wilk test. Since normal distribution was not obtained, the Friedman test was used to analyze within-group repeated measures. The post-hoc analysis was performed using the Durbin-Conover test. The Mann-Whitney U test was applied to compare the laser treatment group and the control group. The significance level was set at $p < 0.05$ for all statistical analyses.

Table 1 Intra-group and inter-group comparison of pain (VAS) scores at each time point between the laser group and the control group

Pain	Laser Group		Control Group		*p*-value
	Mean ± SD	Median (min. – maks)	Mean ± SD	Median (min – maks)	
T0	0 ± 0[a]	0 (0–0) [a]	0 ± 0[a]	0 (0–0) [a]	-
T1	4 ± 1,68[b]	4(1–7) [b]	4,75 ± 1,29[b]	5(2–7) [b]	0,074[2]
T2	1,54 ± 1,45[c]	2(0–4) [c]	1,57 ± 1,6 [c]	2(0–5) [c]	0,972[2]
p-value	< 0,001 [1]		< 0,001[1]		

[1]Friedman test, [2]Mann-Whitney U test, different letters within the same group indicate statistical significance ($p < 0.05$)

SD = Standard Deviation, T0, T1, T2: preoperatively (T0), on the 2nd day (T1), and on the 7th day (T2)

Table 2 Intra-group and inter-group comparison of mouth opening data at each time point between the laser group and the control group

Trismus	Laser Group		Control Group		*p*-value
	Mean ± SD	Median (min. – maks)	Mean ± SD	Median (min. – maks)	
T0	43,57 ± 3,76[a]	45 (35–48) [a]	43,57 ± 3,76[a]	45 (35–48) [a]	1,000[2]
T1	33,43 ± 6,67[b]	35(15–45) [b]	30,86 ± 6,99[b]	35(15–43) [b]	0,170 [2]
T2	36,79 ± 5,61[c]	37(20–47) [c]	35,43 ± 6,3[c]	35 (18–45) [c]	0,397[2]
p-value	< 0,001 [1]		< 0,001[1]		

[1]Friedman test, [2]Mann-Whitney U test, different letters within the same group indicate statistical significance ($p < 0.05$)

SD = Standard Deviation, T0, T1, T2: preoperatively (T0), on the 2nd day (T1), and on the 7th day (T2)

Results

Pain

Table 1 (Comparison of pain (VAS) scores within and between groups at each time point for the LLLT and control groups).

When evaluating pain, statistically significant differences were observed between T0, T1, and T2 in both the laser-treated group and the control group ($p < 0.001$).

A significant increase was observed in the VAS score from T0 to T1, while a notable decrease in VAS scores occurred from T1 to T2 ($p < 0.05$) (Table 2).

There was no statistically significant difference in the VAS scores between the laser-treated group and the control group at T1 and T2 ($p > 0.05$).

Table 3 Intra-group and inter-group comparison of oedema amount data at each time point between the laser group and the control group

Oedema	Laser Group		Control Group		*p*-value
	Mean ± SD	Median (min. – maks)	Mean ± SD	Median (min. – maks)	
T0	98,52 ± 5,08[a]	97,8(86,6-105) [a]	98,35 ± 5,35[a]	97,8 (86,6-105) [a]	1,000[2]
T1	103,47 ± 6,8[b]	105(81,6-113,3) [b]	104,92 ± 5,49[b]	35 (92,3-115) [b]	0,424 [2]
T2	102,25 ± 4,53[c]	102,45(93,3-110) [c]	102,42 ± 4,78[c]	35 (93,3-110) [c]	0,811[2]
p-value	< 0,001 [1]		< 0,001[1]		

[1]Friedman test, [2]Mann-Whitney U test, different letters within the same group indicate statistical significance ($p < 0.05$)

SD = Standard Deviation, T0, T1, T2: preoperatively (T0), on the 2nd day (T1), and on the 7th day (T2)

Trismus

Table 2 (Comparison of mouth opening measurements within and between the laser-treated group and the control group at each time point).

When evaluating mouth opening, statistically significant differences were found between T0, T1, and T2 in both the laser-treated and the control groups ($p < 0.001$).

A decrease in mouth opening was observed from T0 to T1, while a notable improvement in mouth opening occurred from T1 to T2 ($p < 0.05$).

No statistically significant difference was found between the laser-treated group and the control group in terms of mouth opening at T0, T1, and T2 ($p > 0.05$).

Oedema

Table 3 (Comparison of swelling measurements within and between the laser-treated group and the control group at each time point).

When evaluating swelling, statistically significant differences were observed between T0, T1, and T2 in both the laser-treated group and the control group ($p < 0.001$).

Swelling increased from T0 to T1, and a significant reduction in swelling was observed from T1 to T2 ($p < 0.05$).

No statistically significant difference in swelling was found between the laser-treated group and the control group at T0, T1, and T2 ($p > 0.05$).

Discussion

The mandibular impacted third molars (MITM) are known to have the highest impaction rate among all impacted third molars [17]. Third molar surgery is one of the most performed procedures by oral and maxillofacial surgeons [18].

Despite the appropriate application of postoperative patient preparation principles, the use of new techniques during surgery, and careful control of both soft and hard tissues to reduce postoperative complications, some unavoidable complications may still occur.

In particular, pain, swelling, and limited mouth opening are considered the most common postoperative complications [19]. Pain reaches its maximum intensity approximately 3–5 h after surgery and may last for 2–3 days, gradually decreasing within 7 days post-surgery [20, 21]. Additionally, swelling reaches its highest intensity 12 to 48 h after surgery and gradually decreases until the 7th day [22].

The use of local or systemic steroids and non-steroidal anti-inflammatory drugs (NSAIDs) has been recommended to reduce inflammation and pain after third molar surgery; however, these medications have some side effects, including gastrointestinal issues, systemic bleeding, and allergic reactions [23].

Many studies report the therapeutic effectiveness of light amplification by stimulated emission of radiation (LASER) as a biostimulant in the wound healing process [24]. Research has shown that laser treatment can accelerate cell and tissue reconstruction and alleviate postoperative pain [23, 25].

LLLT was initially introduced to dentistry and oral surgery in the early 1970s [23]. While numerous studies have examined the role of LLLT in managing swelling and trismus following impacted third molar extractions, the findings remain inconsistent; some studies report beneficial effects, whereas others do not [26]. In the literature, various parameters for low-level laser therapy have been described [26, 28]. In our study, we utilized the parameters routinely applied in our clinic, which have demonstrated positive effects (wavelength: 940 ± 10 nm, power output: 0.1 W, energy density: 35 J/cm^2, continuous mode, fiber tip diameter: 300 µm, frequency: 50/60 Hz). These parameters were applied using a biostimulation head with a spot size of 1 × 3 cm.

As a result, the ideal parameters for LLLT in achieving biostimulation are yet to be established [22]. Furthermore, research on the biostimulatory impacts of preoperative laser application remains limited.

Lopez-Ramirez et al. [22] reported that low-level laser (810 nm wavelength, 0.5 W power, 5 J/cm^2) intraoral application after the extraction of impacted lower third molars had no beneficial effects on reducing pain, swelling, and trismus. Postoperative treatment included Amoxicillin 750 mg (3 times a day for 1 week), Ibuprofen 600 mg (3 times a day for 2 days), a 15-day regimen of

twice-daily mouth rinses with 0.12% Chlorhexidine, and Metamizole 575 mg.

In our study, LLLT (wavelength 940 ± 10 nm, power output 0.1 W, 35 J/cm^2, continuous mode) was applied both intraoral and extraoral to patients during mandibular impacted third molar extraction. Additionally, considering the gastrointestinal side effects of NSAIDs, a painkiller containing Paracetamol (PAROL) was prescribed. Since the analgesic and anti-inflammatory efficacy of Paracetamol is lower than that of NSAIDs, we aimed to determine the effect of laser treatment more clearly on pain, swelling, and trismus.

Amarillas Escobar et al. [27] found no statistically significant impact on postoperative pain, swelling, or trismus when an 810 nm wavelength laser (100 mW, 4 J/cm^2) was applied both intraorally and extraorally following the surgical removal of mandibular third molars. All patients received 4 mg of dexamethasone intramuscularly one hour prior to surgery. Postoperative care included 750 mg of amoxicillin administered orally every 12 h for 5 days, 500 mg of acetaminophen taken every 6 h for 3 days, and 30 mg of ketorolac prescribed as a rescue medication for intense pain.

In contrast to this study, in our research, LLLT application (wavelength 940 ± 10 nm, power output 0.1 W, 35 J/cm^2) was performed only before the surgery during the extraction of mandibular impacted third molars.

Eshghpour et al. [28] performed a split-mouth randomized controlled trial (RCT) to assess the impact of LLLT on reducing postoperative pain and swelling after mandibular third molar extractions. The study included 40 patients with comparable bilateral impacted wisdom teeth. One side was randomly designated as the experimental group, while the opposite side served as the control. Low-level laser therapy was applied to the experimental side using a 660 nm wavelength (200 mW, 6 J per point at 4 points) intraorally and an 810 nm wavelength (200 mW, 6 J per point at 3 points) extraorally, with the 810 nm irradiation repeated on the 2nd and 4th postoperative days. The control group received standard postoperative care identical to the experimental group but without laser application. Patients were instructed to use postoperative medications, including 500 mg amoxicillin every 8 h for 7 days, 400 mg ibuprofen every 8 h, and a 0.12% chlorhexidine mouthwash twice daily for 10 days. The findings indicated that the experimental group experienced significantly reduced pain and swelling compared to the control group.

In contrast to the study conducted by Eshghpour et al., in our research, LLLT application (parameters: wavelength 940 ± 10 nm, power output 0.1 W, 35 J/cm^2) was performed as a single session before surgery during mandibular impacted third molar extraction. Additionally, Paracetamol-containing (PAROL) painkillers were prescribed instead of NSAIDs. As a result, the effects of laser treatment on pain, swelling, and trismus were more clearly observed in the laser-treated group.

Martinez et al. [29] investigated the use of helium-neon laser therapy to prevent pain, swelling, and trismus following third molar surgery in a randomized clinical trial involving 100 patients. Participants were divided into three groups to receive neon laser therapy, ibuprofen, or placebo. Their findings indicated a significant reduction in trismus in the neon laser and ibuprofen groups. However, the ibuprofen group reported less pain than both the placebo and laser groups. The levels of inflammation, swelling, and trismus were comparable across all groups.

Kazancıoğlu et al. [30] explored the effectiveness of ozone therapy and LLLT for managing postoperative pain, swelling, and trismus after third molar surgery in 60 patients with asymptomatic impacted third molars. Patients were randomly allocated into three groups of 20: one group received 30 s of LLLT (810 nm wavelength, 200 mW), the second group received ozone therapy, and the third served as the control group. Both ozone and LLLT groups exhibited reduced pain levels and fewer analgesics used compared to the control group. The LLLT group demonstrated a significantly greater reduction in trismus compared to the ozone therapy and control groups. Additionally, LLLT effectively reduced swelling, while ozone therapy did not show a noticeable benefit in swelling management. These findings suggest that LLLT and ozone therapy can alleviate postoperative pain and enhance patient comfort. Postoperative care included oral administration of 1,000 mg amoxicillin and 550 mg naproxen sodium, alongside a 0.2% chlorhexidine mouthwash (used for 1 min, three times daily for seven days). Patients were also instructed to apply an ice pack to the surgical area for 30 min.

The study conducted by Goran Batinjan et al. [31] aimed to investigate the adjunctive anti-inflammatory effects of photodynamic therapy and low-level laser on wound healing, pain, swelling, bad breath, and postoperative painkiller use after lower third molar surgery. The results showed that the use of a 660 nm wavelength, 3 kW power, and 4 J intensity laser significantly reduced postoperative painkiller use during the study period. The results indicated excellent outcomes in the laser-treated group, demonstrating that laser therapy significantly reduced postoperative complications in lower third molar surgery.

Ferrante et al. [26] conducted a study on two groups treated with a 980 nm wavelength diode laser, applying 54 J of energy both intraorally and extraoral within 24 h after surgery to treat mandibular impacted third molar extractions. They recorded the number of days and pain levels post-surgery. Statistical analysis showed significant differences in swelling and trismus between the

laser-treated group and the control group, but there was no notable difference in pain levels. They observed that LLLT was more effective when applied extraoral rather than intraoral.

Systematic reviews and meta-analyses conducted on the benefits of LLLT after impacted third molar surgery have shown varying results. In their meta-analysis, Brignardello-Petersen et al. [32] demonstrated that LLLT had only a moderate effect in reducing trismus and no effect on pain or oedema. Similarly, Dawdy et al. [33], in their 2017 systematic review and meta-analysis, found no significant effects of LLLT in preventing postoperative complications.

Cloki et al.[3o], Fernando et al. [35], and Taube et al. [36] investigated the impact of LLLT on pain and swelling following bilateral mandibular third molar extractions. Similarly, Roynesdal et al. [37] assessed the effects of LLLT on swelling, pain, and trismus after bilateral mandibular third molar extractions performed in two separate surgical sessions. Despite employing varying laser parameters, all studies concluded that LLLT did not provide significant benefits in reducing swelling or trismus post-extraction. However, Cloki et al. [34] noted a statistically significant reduction in pain on the day of surgery and the first postoperative day.

However, Carillo et al. [29] reported a statistically significant reduction in trismus in the laser group up to 7 days post-surgery, but no difference was observed between the laser and placebo groups in terms of swelling and pain percentage.

Neckel and Kukizl [38] studied two groups of patients who underwent mandibular third molar extractions, applying 11 J/cm^2 of energy intraorally at 810 nm with a diode laser. They recorded the number of days and levels of postoperative pain. Statistical analysis revealed significant differences, showing lower pain levels and duration in the experimental group compared to the control group.

The variations in the outcomes of these studies may be explained by differences in laser parameters, including preoperative and/or postoperative protocols, wavelength, power output, energy levels, energy density, irradiation frequency and duration, intraoral versus extraoral application, the area exposed to irradiation, and the medical treatments provided.

Limitations

The sample size in our study was relatively limited. Therefore, further clinical studies involving larger populations are needed to evaluate the benefits of low-level laser therapy in oral and maxillofacial surgical procedures. Additionally, we believe that assessing postoperative swelling caused by edema with the aid of three-dimensional photographs could provide more objective results.

Conclusion

In conclusion, within the limits of our study, while pain was lower in the group receiving LLLT, no statistically significant differences were found between the laser-treated group and the control group in terms of VAS scores at T1 and T2 time points. Similarly, no superiority of the laser-treated group was observed in terms of trismus and oedema, according to statistical analysis, although the laser-treated group exhibited less pain, trismus, and oedema.

Further clinical studies with larger populations are needed to evaluate the long-term success of low-level laser therapy in oral and maxillofacial surgical procedures. Additionally, we believe that a more comprehensive investigation of the impact of laser parameters on study outcomes is necessary.

Abbreviations

µm	Micrometer
cm	Centimeter
COX-2	Cyclooxygenase 2
Hz	Hertz
IL-1	Interleukin 1
InGaAsP	Indium Gallium Arsenide Phosphide
J	Joule
LASER	Light Amplification by Stimulated Emission of Radiation
LLLT	Low-Level Laser Therapy
mg	Milligram
MITM	Mandibular Impacted Third Molars
mm	Millimeter
mW	Milliwatt
NaCl	Sodium Chloride
NAID	Nonsteroidal Anti-Inflammatory Drugs
nm	Nanometre
PGE2	Prostaglandin E2
sn	Second
TME	Temporomandibular Joint
TNF	Tumour Necrosis Factor
VAS	Visual Analogue Scale
W	Watt

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-025-05589-z.

Supplementary Material 1

Supplementary Material 2

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Author contributions

Design of the work: EB, SK. İnterpretation of data: EB, SK. Writing the manuscript: EB, SK. Final approval: EB, SK. Acquisition of the data: EB, SK. Writing of the manuscript, final approval: EB.

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None.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The Clinical Research Ethics Committee of the Faculty of Medicine, Recep Tayyip Erdoğan University, with the decision dated 20.07.2022 (2022/05) and by the Turkish Ministry of Health, Medical Device and Drug Authority, with approval number 68869993-511.06-835580. The study was conducted in compliance with the principles outlined in the Declaration of Helsinki. Both written and oral informed consents were obtained from the patients and their legal guardians.

Consent for publication

Informed consent from all subjects for publication of identifying information/ in an online open-access publication has been obtained.

Competing interests

The authors declare no competing interests.

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