Dental Research Journal

Original Article

Low-level laser and management of common complications after the mandibular third molar surgery: A double-blind randomized clinical trial

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ABSTRACT

Background: There are controversies on the analgesic and anti-inflammatory effects of low-level laser therapy on pain, edema, and trismus after mandibular third molar extraction surgery. This study aimed to evaluate the efficacy of low-level laser therapy (LLLT) on discomforts occurring after the mandibular wisdom tooth removal.

Materials and Methods: This double-blind, split-mouth design, randomized clinical trial study was performed on 36 healthy controls with bilateral symmetrical mandibular third molar referred to the Department of Oral and Maxillofacial Surgery of Dental Faculty from January to November 2019. After surgical extraction, the laser group underwent laser (Ga-Al-As diode laser, 808 nm, 200 mW) intraorally and extraorally just after surgery and 24 h after surgery. For the placebo group, the handpiece was inserted without laser irradiation. The pain level was assessed by Baker Wong scale at 2, 4, 6, 12, 24, 36, 48, and 60 h postoperatively, and the edema and the extent of mouth opening were examined before surgery, at the 1st and 7th days after surgery. The data were collected and analyzed by SPSS at the significant level of 0.05.

Results: The statistical analysis of 32 participants' data (laser group: n = 32, placebo group: n = 32) indicated that the mean score of pain in 3 days after surgery in the interventional group was significantly lower than the score of the placebo group (P < 0.001). Furthermore, the swelling and the extent of the mouth opening differed significantly between the two groups at 1st and 7th days after the procedure (P < 0.001).

Conclusion: Our findings showed that the LLLT had beneficial effects on the management of pain, edema, and trismus following after 3rd molar extraction surgery.

Key Words: Edema, low-level laser therapy, pain, third molar, trismus

Received: 24-Jul-2020
Revised: 19-Jun-2021
Accepted: 23-Nov-2021
Published: 18-Jan-2023

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INTRODUCTION

Mandibular third molar surgery, as one of the most common procedures in dentistry, causes various postoperative complications.[1] Among all local signs and symptoms, pain, swelling, and limitation on jaw movement are observed more often[2] which can influence on life quality and comfort of patients.[3] especially during the first 3 days after surgery[4] which

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Website: www.drj.ir
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www.ncbi.nlm.nih.gov/pmc/journals/1480

How to cite this article: Sigaroodi AK, Motevasseli S, Maleki D, Maleki D, Fard RS. Low-level laser and management of common complications after the mandibular third molar surgery: A double-blind randomized clinical trial. Dent Res J 2023;20:14.

is accompanied with the highest pain intensity at 3–5 h after the disappearing of local anesthesia and the peak of swelling at 12–48 h after the operation. The pain and swelling may go on for almost a week.[5,6] That's why clinicians emphasize on the management of these complaints.[7]

The severity of these complications attributes to the complexity of the surgery and individual characteristics such as inflammatory proceed and repair mechanism.[8,9] However, following a standard surgical technique cannot guarantee the lower incidence of symptoms[8] as the irritation of the oral surgical side is due to its moveable location, not the surgery itself.[9]

The use of corticosteroids locally or systemically, analgesics, anti-inflammatory drugs, antibiotics, are recommended[2,3] while their side-effects manifest as allergic reactions, platelet disturbance, gastrointestinal ulcers, and kidney and cardiovascular complications.[4] The application of noninvasive incisions and insertion of drainage tubes are discussed by some researchers too.[8,10] Besides, some studies debated the effects of nonmedication treatments such as cryotherapy, bandage therapy, and low-level laser therapy (LLLT).[1,2,9] Some studies reported that LLLT is tolerated by patients very well as it is a painless and conservative technique and can be employed without the application of anesthesia.[3,11] In addition, the reduction of medicine intake occurring after LLLT has been demonstrated which is related to anti-inflammatory and analgesics effects of the laser.[2,11]

The low-level laser may induce an analgesic effect by facilitating the production of endogenous endorphin, blocking bradykinin, or reducing C-fibers' activity.[5] Its anti-inflammatory consequence is due to inhibition of some mediators such as tumor necrosis factor and interleukin resulting in blood and lymphatic vessels' changes and decrement of edema.[1]

These features of low-power laser therapy are leading to a promising therapeutic approach in the management of surgical side effects.[3] It should be highlighted that efficacy of laser is completely dosage-related and controls by the wavelength of the appliance.[9] However, the evidence supports the use of laser in the primary stages of healing.[12]

According to previous studies, the discussion over laser's performance faces controversial outcomes. For instance, Hamid stated that intraoral GaAlAs are effective to reduce the pain following the mandibular third surgery.[13] On the other hand, Farhadi *et al*. indicated conversely that laser had no significant effects for reduction of pain, swelling, and trismus.[2]

This might be due to the fact that the standard protocol of LLLT has not been determined yet and the articles so far, vary in terms of designs.[10,13-15]

Thus, this survey aimed to evaluate the effects of LLLT on postoperative pain, swelling, and mouth opening.

MATERIALS AND METHODS

The experimental design

This double-blind, split-mouth, randomized clinical trial study was designed based on CONSORT guideline 2010 to assess the efficacy of LLLT on postoperative consequences of mandibular third molars surgery in patients attending to the Oral and Maxillofacial Surgery Department of Dental Faculty from January to November 2019. The approval code was obtained from both the Local Ethics Committee (IR.GUMS.REC.1397.402) and National Clinical Trial Registration Center (IRCT20180826040872). The approved written consent including the aims of the study was signed by all the participants and they all accepted the LLLT after surgery, as well.

Thirty-six patients with bilateral mandibular third molars on panoramic radiographs indicated for extraction surgery for any reasons were selected according to the following criteria by the first therapist.

Inclusion criteria

- Classified as Class 1 by the American Society of Anesthesiology Protocol (no medical history)
- Similar positions of bilateral mandibular third molars based on Pell and Gregory classification in terms of depth and the relation with the anterior border of the mandibular ramus. Also, all the teeth had mesioangular orientation according to Winter's classification.
- Good oral hygiene (without aggressive periodontitis or history of pericoronitis in the previous month.)
- No pathology of adjacent teeth
- No chronic pain
- No neurological or psychiatric disorders
- Nonsmoker and nonalcoholic patients
- Younger than 40 years old
- No pregnant or breastfeeding women.

Exclusion criteria

If the patient underwent any other dental treatment in the period of the study or if he/she used preoperative or postoperative drugs other than ones defined in the protocols or if the allergic reaction to the prescribed local anesthesia or medications was observed, the surgery of both sides was completed for ethical sake but the data were not included. Also, if the patient had any operative complications such as surgical difficulty or long surgical duration, the data were excluded.

The sample size was calculated with a power of at least 95%, correlation of 0.50, and type one error of 0.05 and was determined to be 32 patients to detect the differences. By counting the samples' dropouts, a total of 36 patients were evaluated [Figure 1].

All the surgeries (72 sites) were performed by the same oral surgeon (the first therapist) to solve the diversities among different surgeons.

The interval between two surgery for each patient was 2 weeks to provide healing time and to eliminate the systematic effect of one side on the other side.

The study had the split-mouth design, which means one side of each patient received laser (interventional side) while the other side was the control side. Thus, the biological variation such as the inflammatory process and pain threshold and therefore data collection bias was avoided. To determine the side of intervention, the restricted replacement randomization was performed by a computerized random number. Each block was considered as one person and the block size was 2. So, 36 blocks of 72 surgeries with an allocation ratio of 1:1, were designed as A and B. This corresponds to 36 blocks either AB or BA. The first treatment was considered as laser therapy which means that among all the patients, eighteen patients received their first surgery on the right side (AB) while other patients received their first surgery on the left side (BA) and all of

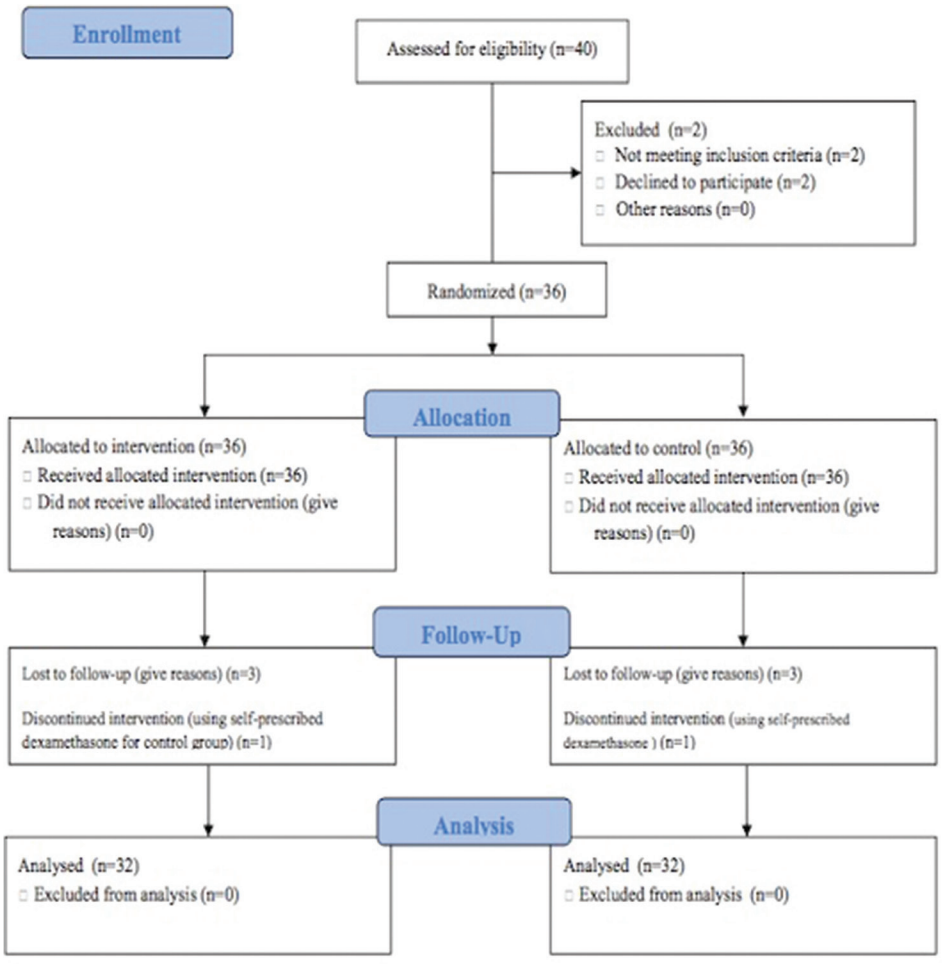

Figure 1: Flow chart of CONSORT.

the patients received the intervention on their first surgery.

For allocation concealment, the randomization letters (A or B) were concealed in sequentially numbered, opaque, sealed envelopes by the statistical specialist and delivered to the second therapist who was responsible for laser application, knew the treatment.

As the study was performed in a double-blind manner, the patients and the therapists except the second one had not known the treatment given for each side and the data were hidden until statistical analysis.

Eventually, the third therapist had measured and recorded all the variables pre- and post-operatively.

Surgical protocol

The demographic information of the patient and the classification of mandibular third molar were recorded before surgery.

The surgeries were conducted by a standard technique. The surgical technique for both sides was similar due to similar classification of the three molars of each participant, but if any changes in the protocol such as additional anesthesia were needed in the first surgery, the assistant documented it so the same protocol was performed for the second surgery. If the modifications occurred in the second surgery, the treatment was completed however the data were not analyzed. Furthermore, the duration of surgery from the first incision to the last suture was recorded.

A 10% povidone-iodine solution (Betadaine®, Nanokimia, Yazd, Iran) were used to disinfect the surgical site before surgery. The 3.6 ml of 2% lidocaine with epinephrine 1:80,000 (Xylopen®, Exir, Tehran, Iran) and 1.8 ml of 4% articaine with 1:100,000 (Dentacaine®, Exir, Boroujerd, Iran) were injected for inferior alveolar, long buccal, and lingual nerve block. A scalpal incision followed by a mesial releasing incision was made by means of blade number 15 (Novacut®, China) according to the tooth position and the full-thickness flap was elevated through Molt periosteal elevator number 9. The osteotomy of bone around the impacted tooth was performed by round carbide bur (Dentsplay, Ballaigues, Switzerland) attached to a low-speed surgical handpiece (NSK, Tokyo, Japan) as needed. Then, the tooth was sectioned employing a fissure bur (Dentsplay, Ballaigues, Switzerland) under irrigation to preserve bone as much as possible.

The proper hemostasis was achieved in the socket and the soft tissue was sutured by a violet braided synthetic absorbable polyglycolate 3.0 suture and 3/8 circle reverse cutting needle (SUPABON, Tehran, Iran). The sutures were removed after 1 week. The postoperative consideration was given in a written form designed by the first therapist. The patients were advised to have soft food on the day of surgery and the next day. Patients were asked to use an ice pack in a 20-min sequence for 24 h but not more as it is of no effect. In addition, they were told to avoid brushing the surgical site or using mouthwash, or spitting on the surgery day. They were suggested to brush the day after surgery but be careful of the sutured site. 400 mg Ibuprofen (Gelofen®, Dana, Tabriz, Iran) every 6 h for 5 days was prescribed postoperatively to reduce pain.

If the patient experienced severe pain, he/she was permitted to take 325 mg acetaminophen-codeine but his/her data were excluded from the study.

Laser parameters

The portable class 3B GaAlAs diode laser device was used (NovoTHOR®, THOR Photomedicine Ltd, USA). The laser was set in continuous mode and the energy was administered at 4.75 W/Cm^2 with a power output of 200 mW and an infrared wavelength of 808 mm.

Before the laser application, the mean power of the handpiece was checked by the probe test part of the device. Furthermore, the LLLT consisted of intraorally and extraorally steps. Initially, the handpiece was placed intraorally and applied for 30 s from the buccal, lingual, and occlusal sides administering a total of 18 J (0.2 W × 90s = 18 J; 6 J at each point). Then, the device was inserted transcutaneously in the wisdom tooth area over the masseter muscle for 30 s (0.2 W - 6 J) in the interventional group. For both groups, the handpiece was held at 1 cm from the area. Meanwhile, for the control side, the same protocol was followed however, the appliance was adjusted to produce the warning sound without laser beam radiation. Following safety principles of international standards, both the patients and the therapist wore protective glasses suitable for a wavelength of 808 nm. The LLLT was performed just after surgery and on the 1st day after the operation (after assessment of edema and trismus parameters).

Outcome measurements (primary outcomes)

Pain

The patients were instructed to mark their pain level at 2, 4, 6, 12, 24, 36, 48, and 60 h after the procedure

in the given recording forms consisted of baker wong face scale (0: No pain – 2: Mild pain – 4: Moderate pain – 6: Severe pain – 8: Extreme pain – 10: The worst pain experienced). The third therapist described the scale marking instruction for all the patients before each surgery.

Edema and trismus

The parameters related to edema and trismus were recorded preoperatively as a baseline by the third therapist. Furthermore, the assessments were repeated on the 1st day (before the second laser therapy) and 7th day (before suture removing) after surgery to compare edema and trismus. Each time the measurement was repeated three times to ensure its accuracy and eventually, their means were reported.

The edema was indicated by using 5 fixed points and 3 lines. The points were: (A) tragus, (B) angle of labial commissure, (C) lateral canthus of the eye, (D) soft tissue pogonion, and (E) Gonion. The 3 lines were AB (Tragus – angle of labial commissure), AD (Tragus – Pogonion), and CE (lateral canthus of the eye – Gonion). The edema was measured by a piece of meter and in millimeters. The trismus was demonstrated recording the maximum opening, between incisal edges of the right maxillary and mandibular central incisors with a millimetric ruler.

Only the data of 32 among 36 patients were analyzed caused 3 patients did not dome for a follow-up examination and the other one used self-prescribed dexamethasone ampule for the side receiving laser therapy.

Statistical analysis

The data were analyzed by software SPSS for windows version 21 (IBM Crop., Armonk, NK, USA). The description of the continuous quantitative variables was expressed by mean, median, minimum, maximum, and standard deviation. Also, for the categorical variables, numbers and percentages were reported. The normality of the distribution of quantitative variables was evaluated by Kurtosis, Skewness, Q-Q Plot chart, Shapiro–Wilk test. Moreover, to compare the complications in the laser group with the placebo group at determined time points, the Wilcoxon test was performed. The changes in postoperative complications were assessed by the Friedman test in each group. A $P < 0.05$ was considered statistically significant.

RESULTS

Of 36 patients, 16 (44%) were female and 20 (56%) were male in the range of 17–35 (mean: 24.97 ± 4.60 years). Among them, four patients had incomplete documentation and only the data of 32 patients were analyzed (14 females and 18 males).

The variables were analyzed by the Friedman test in each group for the differences in the follow-up periods and to compare the interventional and control groups, the Wilcoxon test was conducted (level of signification was 5%).

Pain assessment

In both groups, the pain level had a declining proceed in 3 days significantly ($P < 0.001$).

The mean of the pain level was 3.24 ± 1.64 at the 1st day, 2.21 ± 1.38 on the 2nd day, and 1.37 ± 1.37 at the 3rd day after the surgery in the interventional group while the average of the pain score in the placebo group was 5.92 ± 1.83 at the 1st day, 4.37 ± 1.36 at the 2nd day, 2.78 ± 1.62 at the 3rd day after the surgery. According to these findings, the interventional group had a lower average of pain intensity than the placebo group at the first 3 postoperative days and the difference was statistically significant. The mean, standard deviation, median, minimum, and maximum of the pain score are revealed in Table 1 at each point of time [Figure 2].

Edema assessment

The edema following the extraction on the 1st day after surgery was significantly more than baseline in the interventional and control groups in all the measured lines ($P < 0.001$). Furthermore, the same results were observed on the postoperative 7th day in both

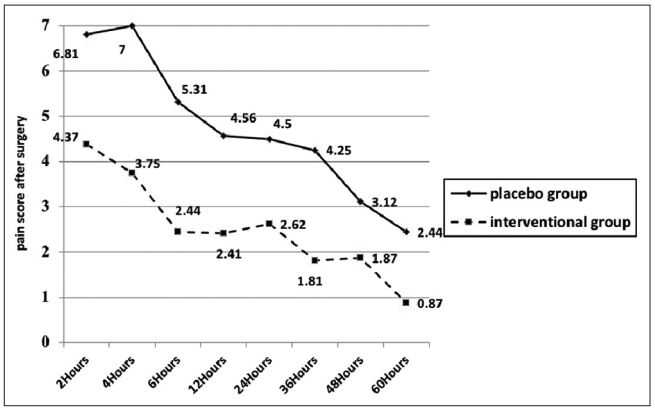

Figure 2: The pain score in the control and interventional groups over time after 3rd mandibular teeth extraction surgery.

groups ($P < 0.001$). In the comparison of the 1st and 7th days, the reduction of swelling was significant through the week in both groups in the tragus – angle of labial commissure line, the tragus – pogonion line, and the lateral canthus of the eye – pogonion line ($P < 0.001$) [Tables 2-4].

Meanwhile, the laser group experienced less inflammation than the interventional group at the days of examination in 3 determined lines and the difference was meaningful based on statistical analysis ($P < 0.001$).

Mouth opening assessment

While the average of the extent of mouth opening was measured as 3.69 mm in the 1st day and 4.32 mm in the 7th day postoperatively in the interventional group, the results were 3.09 mm and 4.01 mm for the control group respectively in the same time [details showed in Table 5].

It was clear that LLLT had significant benefits for trismus by improving the masseter muscle spasm in the interventional sides.

DISCUSSION

There is a global interest in studies evaluating the physiological effects of laser in various medical fields.[2,13] However, investigations reported positive and negative opinions about bio-stimulation properties of laser which is mainly due to a nonstandardization protocols and lack of uniform explanations about laser parameters in the publications.[12,13]

Thus, this double-blind split-mouth randomized clinical trial survey aimed to evaluate the effect of LLLT on postoperative complaints of the mandibular third molar removal surgery.

The statistical analysis showed that the application of diode laser (Ga-Al-As laser, 808 nm, 200 mW) intraorally and extraorally had significant beneficial effects on preventing the postoperative pain level, edema, and trismus on 1st and 7th days after surgery in the interventional group than that seen in the control group.

In similarity to these findings, some investigations revealed evidence of a significant difference between interventional and control groups in terms of postsurgical pain, edema, and trismus.[12-14,16,17]

In a survey performed by Aras and Gungormus, the efficacy of laser with low energy on the trismus and edema following the lower third molar removal was assessed. The LLLT (Ga-Al-As diode laser, 808 nm, 100 mW) was carried out intraorally and extraorally

Table 1: The pain score in the control and interventional groups over 3 days after the mandibular teeth extraction surgery

Time (postoperatively) (h)	Control group (n=32)			Interventional ground (n=32)			Comparison of 2 groups
	Mean±SD	Median (minimum-maximum)	P (Friedman test)	Mean±SD	Median (minimum-maximum)	P (Friedman test)	P (Wilcoxon test)
2	6.81±2.20	8.00 (2.00-10.00)	<0.001	4.37±1.79	4.00 (0-8.00)	<0.001	<0.001
4	7.00±2.15	7.00 (2.00-10.00)		3.75±1.95	4.00 (0-8.00)		<0.001
6	5.31±1.49	6.00 (2.00-10.00)		2.44±1.59	2.00 (0-6.00)		<0.001
12	4.56±1.70	4.00 (0-8.00)		2.41±1.19	2.00 (0-6.00)		<0.001
24	4.50±1.14	4.00 (2.00-6.00)		2.62±1.38	2.00 (0-4.00)		<0.001
36	4.25±1.59	4.00 (0-8.00)		1.81±1.38	2.00 (0-4.00)		<0.001
48	3.12±1.43	3.00 (0-6.00)		1.87±1.43	2.00 (0-4.00)		0.001
60	2.44±1.81	2.00 (0-6.00)		0.87±1.34	0 (0-4.00)		<0.001

SD: Standard deviation

Table 2: Comparison of edema based on the tragus - angle of labial commissure line on the 1st and 7th days after surgery in the control and laser groups (cm)

Points of time	Groups			
	The control group (n=32)		The laser group (n=32)	
	Mean±SD	Median (minimum-maximum)	Mean±SD	Median (minimum-maximum)
Basement	10.62±0.67	10.40 (9.70-11.90)	10.18±2.25	10.50 (2.00-11.90)
1st day after operation	11.59±0.77	11.70 (10.40-13.00)	11.16±0.73	11.20 (10.20-12.50)
7th day after operation	11.10±0.61	11.10 (10.30-12.30)	10.89±0.69	10.90 (10.00-12.00)

SD: Standard deviation

Table 3: Comparison of edema based on the tragus - pogonion line on the 1st and 7th days after surgery in the control and laser groups (cm)

Points of time	Groups			
	The control group (*n*=32)		The laser group (*n*=32)	
	Mean±SD	Median (minimum-maximum)	Mean±SD	Median (minimum-maximum)
Basement	14.87±10.43	15.15 (10.70-16.20)	14.85±1.57	15.05 (10.10-16.10)
1st day after operation	15.71±1.55	15.95 (10.50-17.20)	15.38±1.64	15.75 (10.20-17.00)
7th day after operation	15.29±1.51	15.60 (10.20-16.60)	15.09±1.38	15.40 (10.10-16.30)

SD: Standard deviation

Table 4: Comparison of edema based on the lateral canthus of the eye - pogonion line on the 1st and 7th days after surgery in the control and laser groups (cm)

Points of time	Groups			
	The control group (*n*=32)		The laser group (*n*=32)	
	Mean±SD	Median (minimum-maximum)	Mean±SD	Median (minimum-maximum)
Basement	10.33±0.41	10.20 (9.50-11.50)	10.46±0.42	10.30 (9.90-11.50)
1st day after operation	11.06±0.46	11.00 (10.30-12.00)	10.75±0.49	10.50 (10.00-11.80)
7th day after operation	10.67±0.43	10.70 (9.50-11.50)	10.51±0.39	10.40 (10.00-11.50)

SD: Standard deviation

Table 5: Comparison of maximum mouth opening on the 1st and 7th days after surgery in the laser and control groups (cm)

Points of time	Groups			
	The control group (*n*=32)		The laser group (*n*=32)	
	Mean±SD	Median (minimum-maximum)	Mean±SD	Median (minimum-maximum)
Basement	4.63±0.38	4.60 (4.10-5.30)	4.64±0.34	4.60 (4.20-5.30)
1st day after operation	3.09±0.33	3.00 (2.30-3.80)	3.69±0.35	3.70 (2.60-4.50)
7th day after operation	4.01±0.33	4.00 (3.40-5.00)	4.32±0.37	4.20 (3.90-5.40)

SD: Standard deviation

immediately after surgery and the parameters were controlled on days 2 and 7. The authors verified the positive benefits of LLLT on postsurgical inflammation, in line with our outcomes.[14]

Furthermore, Landucci *et al*. reported that the application of low-power laser as four intraoral and six extraoral doses (Ga-Al-As laser, 10 mW, 780 nm) exactly after the surgery had significant effects on reduction of pain intensity, swelling, and trismus at the postoperative days 2 and 7.[16]

Although in our study the LLLT was performed in 2 sessions and Landucci *et al*.[16] and Aras and Güngörmüş[14] used a single-dose LLLT, the fact that LLLT has the most influence when it is used at the primary phase of healing process regardless to single-dose or double-dose application, led to similar results.[18]

Fabre *et al*. debated about moderating properties of low-level laser on postsurgical discomforts. In this study laser (AlGaInP laser, 35 mW, 660 nm) was irradiated intraorally in 4 points of the surgical site on the 1st day after tooth removal surgery and the other 3 appointments were arranged serially for the next 3 days (4 laser therapy appointments totally). According to the statistical evaluations, not only the facial swelling but also muscle spasm causing trismus returned to preoperative measurements 48 h after surgery in the experimental side than the control side whilst in our study, the inflammation did not disappear completely after a week. Moreover, Fabre *et al*. described that the pain intensity had a descending proceed in both groups. The difference in pain level between the groups on the 1st and 2nd days was not significant but on the 3rd day, it became significant whereas according to our discoveries, the pain level had significant differences on all 3 days after surgery between the groups.[12] The diversity of laser therapy protocols and arrangements can be the cause.[13] In the confirmation of this issue, Herpich *et al*. reported that as long as the methodological

differences exist, the exact results of LLLT cannot be established.[19]

Petrini *et al*. investigated on effects of preoperative LLLT at reducing the postsurgical discomforts following the third molar surgery. In the comparison of pre- and post-operative laser therapy in this study, the results had confirmed that both groups treated employing pre- or post-operative laser device (diode laser, 980 nm, 300 mW) experienced less inflammation related to the extraction than the control group. However, preoperative laser therapy and postoperative laser therapy did not differ significantly. Furthermore, as the intake of analgesic drugs on the day of surgery was significantly more in the group that received postoperative LLLT, the study verified that the preoperative LLLT was more effective at reducing pain level associated with the surgery.[17]

The effect of LLLT was checked on postoperative pain after mandibular third molar extraction in a split-mouth double-blind randomized clinical trial study designed by Hamid.[13] In the article, the experimental side of each patient received laser (Ga-Al-As laser, 810 nm, 100 mW) at 3 points intraorally for a whole week whereas for the control side it was pretended to irradiate laser. It appeared that patients experienced less pain intensity in the side treated with the laser than the placebo side and the difference was meaningful. Therefore, the researcher recommended the highly positive effects of LLLT on postoperative pain control.[13]

On the other hand, the latest systematic review indicated that laser therapy had benefits in terms of anti-inflammatory and analgesic characteristics.[8]

Alan *et al*. stated that the extraoral laser therapy (Ga-Al-As diode laser, 810 nm, 300 mW) performed on the day of surgery and the 2nd day after surgery led to pain reduction significantly only at the 7th day in the laser group in comparison with the control group.[9] Moreover, no significant differences were observed in edema measured by three-dimensional photographic image method and trismus at the 2nd and 7th days after procedure between the laser and control groups[9] similar to the statements of Koparal *et al*. study.[20] The controversy between the results related to pain level can be due to performing laser therapy extraorally which is not adequate for controlling the pain intensity according to Kahraman *et al*. survey in which the superiority of intraoral LLLT over extraoral LLLT was proved.[21]

Concerning results describing the swelling changes, it should be noted that Alan *et al*.[9] and Koparal *et al*.[20] the blinding was not considered which can directly cause bias.[2]

Farhadi *et al*. demonstrated that the laser (550 nm, 100 mW) applied immediately after the operation at the angle of the mandible and inside the socket of 3rd mandibular molar, was not efficient in the improvement of pain, swelling, and trismus on the day after surgery and a week later. In addition, their finding, in contrast to the outcome of the current study, confirmed that LLLT did not provide any benefits as an adjuvant approach which can be the result of emitting laser beam with inappropriate wavelength and energy.[2] As the study did not consider a split-mouth design, the bias in data collection was highly possible which have a direct influence on the results.[13,22]

Zaied *et al*. compared the efficacy of LLLT (Ga-Al-As diode laser, 950 nm, 15 mW) and dexamethasone phonophoresis prescription on the management of trismus and edema occurring after third molar extraction. The patients in the laser group underwent LLLT extraorally for 7 sessions during the week after surgery which each session took 6 min. While those in the dexamethasone group underwent ultrasound with dexamethasone gel for a 7-day period and the phonophoresis was evaluated. Based on their outcomes, the affection of dexamethasone phonophoresis on trismus and edema 48 h and 7 days after operation was significantly determined while LLLT was meaningfully effective only for postsurgical trismus and had no benefits for edema decline. Eventually, the study concluded that these methods didn't differ significantly.[3]

Although this study and our research used the same points and lines to measure postoperative swelling, our outcomes confirmed the efficacy of LLLT on limiting inflammatory process significantly which can be the result of using laser both intraorally and extraorally (for 2 min in overall at the first 2 days) whilst in Zaied *et al*. study the laser was emitted only extraorally (for 6 min over a week).[3] Therefore, this controversy can be due to the difference in laser therapy protocol.[13] On the other hand, the design of Zaied *et al*.'s study[3] was not split-mouth similar to Farhadi *et al*. study.[2] That means the variation of the individual characteristics such as the inflammatory

reactions were not eliminated which can affect the conclusions.[13]

The variation in statements of mentioned studies could be due to different study designs, different pre- or post-operative medications, different laser type, dissimilar arrangement of laser parameters such as wavelength, power, amount of energy, and duration, variation of probe size, varied sessions of LLLT (preoperatively or postoperatively), application area (intraoral or extraoral), numbers of points receiving laser, and different distance from the target tissue.[2,23] One of the limitations of this study is the difference between the mentioned parameters of this study and previous investigations. Further studies should be conducted with a similar methodology so that evaluating the efficacy of low-level lasers and concluding a univalent outcome be possible.

CONCLUSION

Based on statistical analyses of the data concerning the limitations of this study, the use of Ga-Al-As diode laser of 808 nm and 200 mW intraorally and extraorally is of significant benefit for the management pain, edema, and trismus following surgical removal of 3rd molar of the mandible on the 1st and 7th days after surgery.

Financial support and sponsorship
Nil.

Conflicts of interest
The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

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