

Original Article



Effect of Low-Level Laser Therapy on Trismus, Facial Swelling, and Pain Following Surgical Extraction of Impacted Lower Third Molars

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Abstract

Background: Light amplification by the stimulated emission of radiation (laser) is currently used as a therapy method for decreasing inflammation followed by oral surgeries. Therefore, the present study aimed at evaluating the effect of using diode low-power laser irradiation (photobiomodulation) on the amount of pain, swelling, and trismus due to latent mandibular third molar surgery (surgical removal of latent mandibular third molars).

Methods: In this double-blind randomized clinical trial study, 16 individuals with latent mandibular third molars with an identical condition were selected. The teeth were randomly assigned to two groups of laser irradiated intervention group and a non-irradiated control group. A 940 nm diode laser with an output power of 200 mW and an energy density of 12 J/cm² was applied for 60 seconds at a distance of 1 cm three intraoral points and an extraoral point. The distance between incisal edges of upper and lower central teeth, the horizontal distance between corners of lips and auricle (LE), the vertical distance between the outer canthus of the eye and the mandibular angle (EA), and pain visual analogue scale were measured before surgery and two and seven days after surgery.

Results: There was no statistically significant difference between the two groups regarding EA and LE before intervention and on days 2 and 7 after intervention ($P > 0.05$). However, the pain score was significantly higher before intervention (3.31 ± 0.7 vs. 2.38 ± 0.8 , $P = 0.001$) and on day 2 after intervention (6.5 ± 1.32 vs. 4.5 ± 0.97 , $P < 0.001$) in the control group. On day 7, a higher maximum jaw opening (MJO) was observed in the intervention group (40.68 ± 5.76 vs. 36.81 ± 4.35 , $P = 0.04$).

Conclusions: Adjunctive diode laser photobiomodulation after third molar surgery was associated with a significant reduction in pain and trismus.

Keywords: Laser therapy, Pain, Swelling, Maximum mouth opening, Photobiomodulation



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Introduction

One of the most common surgeries in the oral cavity is the extraction of impacted third molars which is usually performed under local anesthesia (1). Although the surgical process is not extensive regarding the trauma to the bone and soft tissue and the anatomical position of the area, it can lead to considerable inflammation and post-surgical complications for the patient (2). Moreover, due to physiological changes that occur (e.g., bleeding, swelling, stiffness, and pain), the quality of life of the

patients decreases, and their activities such as eating and talking could be disrupted for about one week (3).

Light amplification by the stimulated emission of radiation (laser) is electromagnetic radiation, which has coherence, monochromaticity, and unidirectional properties unlike usual light. Different laser radiations are categorized based on their wavelength and absorbance in tissue, which may result in different applications. High-power laser radiations are usually used in surgeries, dermatology, and ophthalmology, while low-power laser



radiations have such action as a bio-modulator, and many studies showed the effect of low-level laser therapy on cells and improving wound healing, decreasing pain, and facilitating the inflammation process (4-8). Moreover, its effects in dentistry have been assessed on dentinal sensitivity, temporomandibular problems, paresthesia of the lower jaw nerve due to trauma, herpetic ulcer healing, and the like (9-12).

So far, different methods have been used to reduce post-surgical complications of impacted third molar extraction such as the use of corticosteroids, non-steroidal anti-inflammatory drugs, drain, and low-power lasers (13-16). However, using low-power lasers is recommended due to their negligible side effects (17).

Since the results of available studies on photobiomodulation effects on pain, swelling, and trismus after impacted third molars surgical extraction are different, and different wavelengths and irradiation protocols play an important role (18-23), the present study was designed to assess the effect of using a 940 nm adjunctive laser irradiation on pain, swelling, and trismus after surgical extraction of the impacted mandibular third molars.

Materials and Methods

This double-blind randomized clinical trial study was conducted on 16 patients from volunteers referring to the Oral and Maxillofacial Surgery Department for surgical extraction of their impacted mandibular third molars. The inclusion criteria were a maximum age of 25 years and having a bilateral third molar tooth with equal latency type based on the classifications by Pell (24). The study was approved by the Research Ethics Committee of Hamadan University, and all patients signed an informed consent form for participation in the study.

Before surgery, maximum jaw opening (MJO) as well as the distance between incisal edges of upper central incisor and lower central incisor were measured. Likewise, the horizontal distance between lip commissure and tragus (LE) and the vertical distance between the outer canthus of the eye and mandibular angle (EA) were measured using Silk Sutures and recorded in millimeters for each patient.

A mandibular third molar tooth of one side was randomly allocated to each patient in the intervention group (laser radiation), and the other was assigned to the patients in control group (placebo irradiation). The teeth were removed at a two-week interval. Lower alveolar and buccal nerve anesthesia were achieved using 2 capsules of Lidocaine with 1:100000 epinephrine concentration. For all patients, a triangular flap was established to provide the required visibility and access. After surgery, the flap areas were closed using Silk Sutures, version 3.0 (Supa, Tehran, Iran).

In the intervention group, a continuous wave with 940 nm (Epic 10, Biolase, USA) diode laser with an output power of 200 Mw was irradiated for 60 seconds at a distance of 1cm from the tissue to achieve a 12 J/cm² energy density on three intraoral points on the mandibular raphe, the sutures, and the buccal vestibular

area of the surgical site. An extraoral site 1cm above the mandibular border at the origin of the master muscle was also irradiated with the same setting. The irradiation was performed in two sessions: immediately after surgery and 48 hours after laser. In the control group, a laser that was not turned on was applied in a completely similar manner. All surgeries were performed by an experienced oral and maxillofacial surgeon.

To decrease the possibility of wound infection, a 500 mg amoxicillin capsule was used every 8 hours for one week, and a chlorhexidine 0.2% mouthwash was prescribed for each patient twice a day for one week. The patients were allowed to use acetaminophen analgesics if needed but had to write down the number of pills used.

The distances measured before surgery were measured again two and seven days after surgery. Measurements were performed by an individual who was blinded to control and intervention groups. Moreover, for measuring pain level, a visual analogue scale was used at the defined time points after surgery (after elimination of anesthesia, and 1, 2, and 7 days after surgery). For this purpose, the patients were asked to score their pain rate from 1 to 10. Collected data were entered into SPSS version 24 software and analyzed using an independent T-test and Man-Whitney test. Further, the significance level was considered less than 0.05.

Results

Initially, a total of 23 patients were enrolled in the study. Considering the inclusion and exclusion criteria, 7 patients were excluded, and 16 patients were included in the final analysis (8 males and 8 females). The mean age was 21.45 ± 2.64 s (Range 19-25) years.

The comparison of EA, LE, pain, and MJO between the intervention and control groups is presented in Table 1 and Figure 1. As it can be observed, EA measurements indicated no statistically significant difference between the two groups before intervention and on days 2 and 7 after intervention ($P > 0.05$). Pain in both groups on day 2 increased and afterward declined by day 7 after intervention. However, the pain score was significantly higher immediately after surgery (3.31 ± 0.7 vs. 2.38 ± 0.8 , $P = 0.001$) and on day 2 after intervention (6.5 ± 1.32 vs. 4.5 ± 0.97 , $P < 0.001$) in the control group compared with the intervention group.

MJO in both groups, after a slight decrease on day 2, increased on day 7 after the intervention in both groups. However, only on day 7 after intervention, this index was significantly higher in the intervention group (40.68 ± 5.76 vs. 36.81 ± 4.35 , $P = 0.04$). Further, there was no significant difference in terms of the score of LE between the two groups immediately after surgery as well as 2 and 7 days after intervention ($P > 0.05$).

Discussion

This randomized clinical trial was conducted to investigate the effect of diode laser on the amount of pain, trismus,

Table 1. Comparison of EA, Pain, MJO, and LE Between the Intervention and Control Groups

Index	Time	Intervention Group	Control Group	P Value
EA	Immediately after surgery	105.93±6.39	105.63±6.35	0.89
	Day 2	109.19±6.94	110.63±6.59	0.55
	Day 7	106.06±6.52	106.76±6.53	0.77
Pain score	Immediately after surgery	2.38±0.8	3.31±0.7	0.001*
	Day 2	4.5±0.97	6.5±1.32	<0.001*
	Day 7	1.5±0.89	2.43±1.89	0.08*
MJO	Before intervention	45.94±5.58	45.38±5.67	0.78
	Day 2	34.5±6.79	30.5±6	0.09*
	Day 7	40.68±5.76	36.81±4.35	0.04*
LE	Before intervention	108.68±6.03	108.12±6.52	0.8
	Day 2	111.5±6.06	115.75±6.33	0.06*
	Day 7	109.75±5.95	109.75±6.67	1

Note. MJO: Maximum jaw opening; LE: Horizontal distance between lip commissure and tragus; EA: Vertical distance between outer canthus of eye and mandibular angle.

and swelling caused by latent mandibular third molar surgery. Different methods are available to measure the amount of swelling in the face. For example, in the study by Alan et al different rates of post-surgical swelling were found using 3-D scans of patients (25). However, in some previous studies, contact and direct measurements have been utilized (26,27). The current study also evaluated the amount of swelling by measuring the horizontal distance between the corners of lips and auricle and the vertical distance between the outer canthus of the eye and the mandibular angle.

Previous studies have shown that the amount of pain reached its maximum 3-5 hours after surgery, lasted for about 2-3 days, and then reduced until the seventh day (28). The results of the current study also revealed that on the seventh day, when the amount of pain greatly reduced, no difference was found between the two groups, but on the second day after the surgery when we expect the maximum pain, laser radiation significantly reduced pain reported by patients.

In previously conducted studies on the effect of laser on latent mandibular third molar surgery, the first laser to be studied was the He-Ne laser, which had no significant effect on pain and swelling after surgery in a study conducted by Carrillo et al but improved the amount of trismus significantly after one week (29).

The most common laser used in studies is the diode laser. In two separate studies, Markovic et al found that the use of diode laser (AlGaAs) wavelength /setting significantly improved the pain of patients as well as the amount of swelling that occurred after latent wisdom teeth surgery (20,21). In a study by Maria et al, patients with two latent mandibular third molars after surgery had one side under a low-power diode laser with a wavelength

of 810 nm, power of 0.5 W, and density of 5 J/cm², and it was observed that the use of diode laser did not have a significant effect on the amount of pain, swelling, and trismus caused by latent mandibular third molar surgery (30). In a study by Raiesian et al selected 44 patients with latent mandibular third molar surgery and examined the effects of low-power diode laser radiation with wavelength of 980 nm, power of 1.8 watts, and energy density of 18 J/cm². The results showed that the use of diode laser had a significant effect on pain reduction after mandibular third molar surgery, but no significant effect was reported for the amount of swelling induced by surgery (27). Similarly, the results of the present study indicated that the use of diode laser had a significant effect on the reduction of pain and trismus following the latent mandibular third molar surgery. Compared to previous studies, it can be concluded that the radiation characteristics used (i.e., radiation wavelength and energy) could contribute to the difference in reported results.

Differences in irradiation protocols may also play a role in the variations in outcomes. In this study, we used a laser immediately after surgery and 48 hours after later. Røynesdal et al evaluated the effect of diode laser radiation before and after surgery on the amount of pain, trismus, and swelling, observing that laser radiation did not have a significant effect (31).

Some studies, in addition to the intraoral application, applied a laser extraorally similar to the design of the present study. For example, Aras and Güngörmüş used a diode laser both inside and outside the mouth and observed that the amount of trismus and swelling in the patients reduced significantly after 2 and 7 days (18). In another study, Aras and Güngörmüş addressed the effect of diode low-power laser inside and outside the mouth on the amount of trismus and swelling after latent mandibular third molar surgery. These were in accordance with the findings of the present study. These findings may indicate that the use of adjunctive low-power laser irradiation extraorally may have a greater effect on the reduction of swelling and trismus (19). However, Alam et al used extraoral application of diode laser immediately and 2 days after surgery, finding no significant laser-induced effects, except for the reported pain on the seventh day (25). In the present study, we used a different protocol; in other words, the laser was used immediately after surgery and 48 hours later, intraorally and extraorally on the site of the Masseter muscle, and the results indicated the positive effects on reduction of trismus measured via MJO.

In the current study, to reduce confounding factors, patients with a similar bilateral latent mandibular third molar and degree of surgical difficulty were studied in a double-blinded split-mouth design.

The obtained results demonstrated a positive effect of adjunctive low power laser photobiomodulation on the complications of latent mandibular third molar surgery. These results may be due to the underlying mechanism of action of low-level laser therapy on synthesizing and

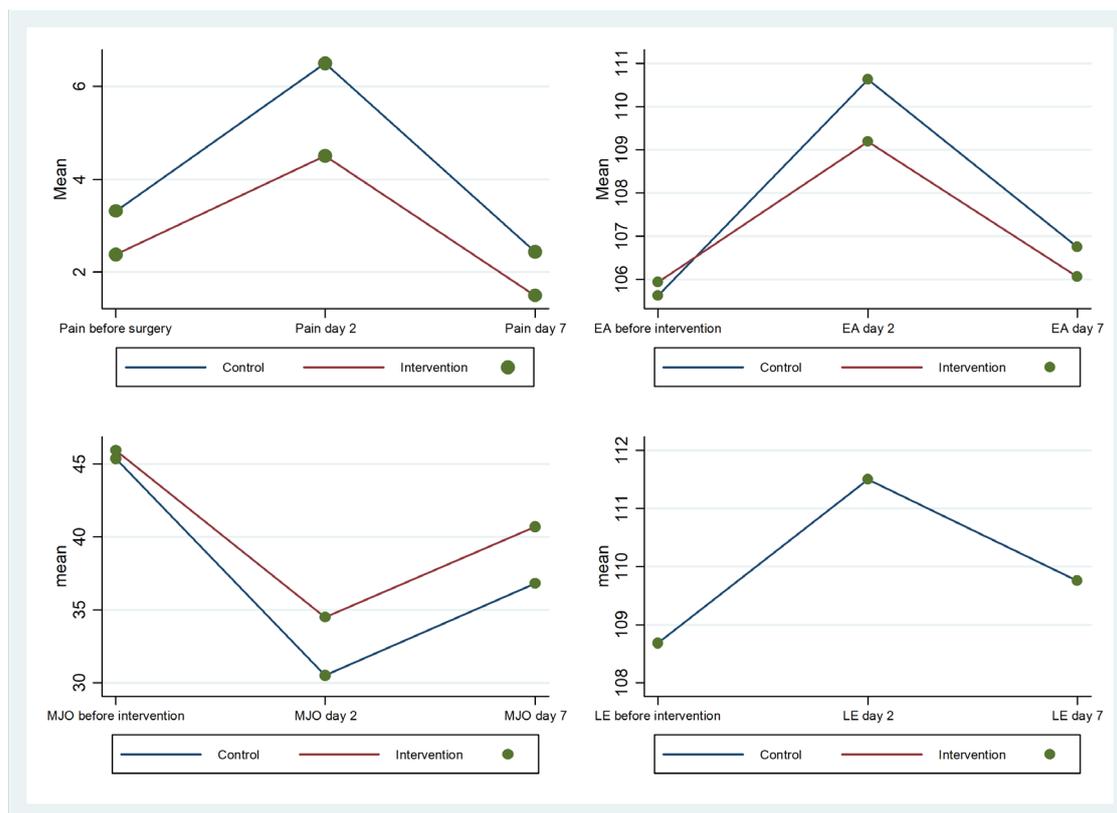


Figure 1. Graphical Presentation of Comparison of EA, Pain, MJO, and LE Between the Intervention and Control Groups. *Note.* MJO: Maximum jaw opening; LE: Horizontal distance between lip commissure and tragus; EA: Vertical distance between outer canthus of eye and mandibular angle.

releasing endorphins, increasing the threshold for pain tolerance, and blocking neurons, which can reduce pain sensation. Moreover, improved postoperative inflammation and swelling can be achieved by increasing the number and diameter of lymphatic vessels, reducing vascular permeability, as well as controlling inflammatory mediators such as PGE, IL-6, and IL-10 (32-36).

Conclusions

According to the results of the current study, adjunctive intraoral and extraoral diode laser photobiomodulation significantly reduced pain and trismus after latent mandibular third molar surgery.

Authors' Contribution

All authors equally contributed to the design and implementation of the research, analysis of the results, and writing the article.

Conflict of Interest Disclosures

The authors declare that they have no conflict of interests.

Ethical Statement

The present study was approved by the Ethics Committee of the Hamadan University of Medical Sciences and was performed in accordance with the Declaration of Helsinki. Moreover, all patients expressed their willingness to participate in the study (IR.UMSHA.REC.1396.471).

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