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ORIGINAL ARTICLES

Evaluation of adjunctive effect of low-level laser Therapy on pain, swelling and trismus after surgical removal of impacted lower third molar: A double blind randomized clinical trial

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Background and Aim: Wisdom teeth remains impacted in the jaw due to several reasons and surgery of impacted wisdom teeth is one of the most common surgeries in dental clinics. Pain, swelling and trismus are the common complications after this surgery which affect quality of life. In articles, various methods are introduced to control immediate inflammatory-response associated with third-molar surgery. The aim of this study is to evaluate the adjunctive effect of low-level laser Therapy on pain, swelling and trismus after surgical removal of impacted lower third molar.
Materials and Methods: This double-blind randomized controlled trial (RCT) was conducted on two groups of 24 patients (age range of 18-35) that had referred to surgical ward of Faculty of Dentistry, Tabriz University of Medical Sciences for surgery of their mandibular third molar(2015-16). All the subjects were systemically healthy and had at least one impacted mandibular third molar. After surgery, in experimental group, the laser was applied intraorally (inside the tooth socket) and extraorally (at the insertion point of the masseter muscle) immediately after surgery in contact with the target area for 25 seconds each. The laser energy was 2.5 J per area with an energy density of 5 J/ cm^2 at the surface of the probe (spot size= 0.5 cm^2). In the other group, as the control group, it was pretended to radiate. Trismus, pain, and swelling were evaluated on the first and seventh days after surgery. The obtained data were evaluated using SPSS 16 software and independent samples T-test.
Findings: In the group where LLLT had been used, P> 0.05 was calculated for pain, swelling, and trismus on days 1 and 7 after surgery that was not statistically significant.
Conclusion: Under limitations of this study, using low-power laser with mentioned parameters, clinically reduces pain, swelling and trismus after surgical removal of impacted mandibular wisdom, but not statistically significant.

Keywords: Low level laser Therapy (LLLT) · Trismus · swelling · Pain, Lower third molar

Introduction

Wisdom teeth remains impacted in the jaw due to several reasons like high density of bone, the status of adjacent teeth, thick mucus, and genetic factors. The prevalence of impacted lower wisdom teeth is 20%-

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30% of the population, so surgery of impacted wisdom teeth is one of the most common surgeries in dental clinics [1, 2]. Pain, swelling and trismus are the common complications after third molar surgery. These complications affect quality of life [3]. Reducing postoperative complications is one of the essential principles of dentistry [4].

In articles, various methods are introduced to control immediate inflammatory-response associated with third-molar surgery. These methods include closing the surgery site with or without the use of drain and the use of drugs such as analgesics, corticosteroids, and antibiotics. Other methods reported include physical therapy methods including cryotherapy, bandage therapy, and the use of laser [5-8].

In the study by Khorasani (1977), 50 mg prednisolone was used to reduce swelling, and the results showed a clear reduction in swelling after dental surgery by oral prednisolone [9]. In the study by Schmelzeisen et al. (1993), the use of dexamethasone to reduce pain and swelling was reported effective [10]. Given the side effects of systemic drugs, other methods such as ultrasonic and laser are used to reduce complications [11].

The biological effect of using LLLT was studied in 1967, the concept of treatment with lasers began to take shape in 1971, and since then, it has been used in the treatment of many disorders such as rheumatoid arthritis, osteoarthritis, carppel tunnel syndrome, and so on [12-14].

It seems that LLLT has many advantages in controlling the swelling process by reducing pain and increasing speed of tissue repair in patients without any complications. 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 bio-chemical material. The mechanism of LLLT is complex. In general, anti-inflammatory effect of laser is based on reducing the accumulation of PGE2, inhibiting the effects of IL-6, IL-10, MCP-2 and TNF-α in acute inflammatory phase. Furthermore, this effect is strengthened with the help of change in the permeability and channel size of lymph and blood vessels [12, 13].

LLLT has been used for the prevention of swelling and trismus after the removal of impacted third molars, after periodontal surgery procedures, for the management of chronic facial pain, chronic sinusitis, gingivitis and sensory abnormalities in the inferior alveolar nerve [15]. However their applications are numerous, the results about their efficacy for the prevention of pain, postoperative swelling, and trismus after the surgery, are controversial. This may be due to methodological differences used in the different studies, depending on the type of laser and the laser application factors [12, 16].

The aim of this controlled clinical trial is to evaluate the efficacy of low-level diode laser 550 nm in reducing pain, swelling, and trismus after removal of impacted mandibular third molar by surgery. In the zone of wounds, conditions are usually created inhibiting proliferation such as low oxygen concentration or PH. The exposure to red or near infrared light might thus serve as a stimulus to increase cell proliferation. Since the wavelength of 550 nm has less penetration depth and resulted in photobioactivation of the target cells through a direct light-cell energy exchange, it seems to create some beneficial therapeutic effects, including better wound healing, pain reduction and enhanced repair of soft and hard tissue injuries. Also, irradiation in the extraction socket could gain advantage of photocoagulation and photobiomodualtion by using the low power of 550 nm laser which high absorption by hemoglobin [17, 18].

Methods

This study was conducted through RCT on two groups of 24 patients in the age range of 18-35, who were systemically healthy and had at least one impacted mandibular molar that had referred to surgical ward of Faculty of Dentistry, Tabriz University of Medical Sciences for surgery of their mandibular third molar in 2015-2016. All the subjects were matched for age, gender and classification of impaction (according to Bell & Gregory classification [19]) and inclination of teeth. Individuals with any systemic disease, topical infections such as pericoronitis, history of using tobacco and drug such as oral contraceptives, poor oral hygiene and pregnant women were excluded from the study.

The study has been approved in the ethics committee of Tabriz University of Medical Sciences and Iranian Registry of Clinical Trials (IRCT). Informed consent has been obtained from all patients as well.

Patients were randomly selected. One surgeon in the same condition performed wisdom tooth surgery of all the patients. In all patients, a daily dose of 1.5 grams amoxicillin (500 mg capsule three times a day) and 3 gelofen tablets 400 mg were administered for 5 days. The surgery was performed under local anesthesia. Inferior alveolar nerve block and long buccal injection for the patients was carried out using cartridges

containing lidocaine 2% with epinephrine 1.80000.

At completion of the surgery, in one of the groups, randomly as the experimental group, the laser was applied intraorally (inside the tooth socket) and extraorally (at the insertion point of the masseter muscle) immediately after surgery in contact with the target area for 25 seconds each. The laser apparatus emitted a wavelength of 550 nm and operated at the power of 100 mW and continuous wave mode. The laser energy was 2.5 J per area with an energy density of 5 J/ cm^2 at the surface of the probe (spot size= 0.5 cm^2). In the other group, as the control group, it was pretended to radiate.

Trismus, pain, and swelling were evaluated on the first and seventh days after surgery. Assessments and measurements were conducted by a person who was not aware of the type of group and in double-blind way. The measuring method of the main objective variables was as follows:

A) Pain was measured by VAS system on the first and seventh postoperative days. In fact, the absence of pain received zero, low pain one, and based on pain intensity, respectively, the patients chose a number from 0 to 10 by the questionnaire that given to them after surgery.

B) Measuring postoperative swelling was performed by measuring ear tragus to the corner of the mouth using a millimeter ruler. Preoperative measurements were used as a reference for determining cheek-swelling rate on the first and seventh days after surgery.

C) Trismus was determined by measuring the maximum opening of mouth by millimeter ruler. The patients were asked to open their mouth as much as possible and at the same time, the right edge of the incisor to the bottom was measured in all patients in both groups before and after surgery on the first and the seventh days.

The obtained data were evaluated using SPSS 16 software and independent samples T-test and Mann-Whitney test. P-value less than 0.05 was considered significant in the study.

Results

Of 48 patients, 24(50%) were male and 24(50%) were female in the age range of 18-35(Average: 24.3 ± 2.1). Trismus, pain, and swelling were compared on the first and seventh days after surgery between two groups. Considering that the amount of swelling, pain, and trismus for the control and experimental groups was compared in two different statistical society, we used independent samples T-test.

Trismus

The difference in trismus between the groups before surgery, on the first and seventh days after surgery was not statistically significant **(Table 1)**.

The average trismus reduction to the seventh day in the experimental group was 3.3 ± 2.7 mm and in the control group, it was 2.2 ± 1.6 mm. But this finding was not statistically significant (P = 0.09 and T = 1.7).

According to information obtained, the first hypothesis is not confirmed, and in fact, the use of low-power laser in trismus reduction after surgical removal of lower-wisdom teeth is not statistically significantly effective.

Table 1: The average mouth opening (mm) before surgery, on the day after surgery, and seven days after surgery in the experimental and control groups

	Mouth Opening		
Time / Groups	Before surgery	First day	seventh day
Control group	41.08 ± 5.2	36 ± 4	37 ± 4.6
Experimental group	41.06 ± 4.45	36.8 ± 6.7	39.4 ± 5.6
Independent samples T-test	P = 0.9 T = 0.01	P = 0.6 T = 0.5	P = 0.11 T = 1.6

Pain

The difference between the average pain before surgery, on the day after surgery, and seven days after surgery in the experimental and control groups was not statistically significant **(Table 2)**. Average decrease in pain until seventh day in the control group was 2.7 ± 0.6 and in the experimental group, it was 3 ± 1.1. The difference between the two groups in terms of pain relief until the seventh day was statistically significant (P=0.24, T = 1.17).

According to information obtained, the use of low-power laser in pain reduction after surgical removal of lower-wisdom teeth is not statistically significantly effective, but it is useful in terms of pain relief until the seventh day after surgery.

Swelling

The difference between the average swelling before surgery, on the day after surgery, and seven days after surgery in the experimental and control groups was not statistically significant **(Table 3)**. Average decrease in swelling until seventh day in the control group was 2.9 ± 1.5 and the experimental group, it was 4.33 ± 1.29. The difference between the two groups in terms of reduction of swelling until the seventh day was statistically significant (P=0.0009, T = 3.5).

According to information obtained, the use of low-power laser in swelling reduction after surgical removal of lower-wisdom teeth is not statistically significantly effective, but it is useful in terms of swelling relief until the seventh day after surgery.

Table 2: The average pain before surgery, on the day after surgery, and seven days after surgery in the experimental and control groups

	Pain		
Groups \ Time	Before surgery	First day	seventh day †
Control group	0.2 ± 0.1	3.9 ± 1.7	1.29 ± 1.1
Experimental group	0.2 ± 0.1	3.8 ± 1.7	0.9 ± 0.7
Independent samples T-test/ Mann-Whitney test	P = 1 T = 0	P = 0.8 T = 0.2	P = 0.28 T = 1.1

† The distribution of seventh day data was not normal. Therefore, the non-parametric statistical method has been used (Mann-Whitney test).

Table 3: The average Ear tragus to the corner of the mouth distance (mm) before surgery, on the first and seventh days after surgery

	Mouth Opening		
Groups \ Time	Before surgery	First day	seventh day
Control group	109.1 ± 4.7	116 ± 5.2	113 ± 4.8
Experimental group	109 ± 5.07	116 ± 4.27	111 ± 4.3
Independent samples T-test	P = 0.9 T = 0.7	P = 1 T = 0	P = 0.13 T = 1.5

Discussion

Impacted wisdom teeth surgery is one of the most common surgical procedures in dental clinics [1, 2]. It seems that LLLT has many advantages in controlling the inflammatory process by reducing pain and increasing speed of tissue repair in patients without any complications. LLLT has been used in the treatment of many disorders such as rheumatoid arthritis, osteoarthritis, carppel tunnel syndrome, and so on [12, 13].

In this study, the efficacy of low-level diode laser 550 nm in reducing pain, swelling, and trismus after removal of impacted mandibular third molar by surgery was studied. Our study showed that the use of LLLT as adjuvant treatment is not useful for reducing pain, swelling, and trismus and does not have clinically significant effects. It seems that in this study, the administration of antibiotic medication and analgesic around the clock for 5 days, is the main factor in reducing complications rather there is no effect of LLLT. In similarity to the results of this clinical trial, several investigations reported no evidence of a difference in pain, swelling and trismus between the laser and control groups after surgery [12, 20, 21].

Lopez-Ramirez et al. (2012) reported that the intraoral application of a low-level laser (810 nm, 0.5 W, 5 J/cm^2) did not has beneficial effects of decreasing pain, swelling, and trismus after elimination of impacted lower third molars. The medication recommended after surgery was 750 mg of Amoxicillin (orally every 8 h for 7 days), Ibuprofen 600 mg (orally every 8 h for 2 days), rinsing twice a day for 15 days with Chlorhexidine 0.12% and Metamizol 575 mg as rescue medication [12].

AmarillasEscobar et al. (2010) reported no statistically significant effect on postoperative pain, swelling, and trismus after using an 810 nm wavelength laser (100 mW, 4 J/cm^2 used intraorally and extraorally) after surgical removal of third molars. Dexamethasone 4 mg intramuscularly was prescript to all patients 1 hour before surgery. Postoperatively, they received amoxicillin (750 mg orally every 12 hours for 5 days), acetaminophen (500 mg orally every 6 hours for 3 days), and - in case of strong pain - ketorolac 30 mg as rescue medication [20].

A latest systematic review and meta-analysis indicated that LLLT provides no benefit on pain and swelling and a moderate benefit on trismus after mandibular third molar surgery [22].

In contrast, other investigators stated a meaningful reduction in postoperative pain and swelling levels in patients who underwent LLLT after third molar surgery [13, 23, 24].

Eshghpour et al. designed a study (2016) to evaluate the effect of LLLT in reducing swelling and pain after surgery of impacted lower wisdom teeth, which was a split-mouth RCT study, was conducted on 40 patients with similar bilateral impacted wisdom teeth. One of the sides was randomly selected as the experimental group and the other as the control group. The experimental side received Low Level Laser Irradiation with wavelength of 660 nm (200 mW, 6 J per point at 4 points) inside the mouth and 810 nm laser (200 mW, 6 J per point at 3 points) outside the mouth. Irradiation at the 810-nm wavelength was repeated on days 2 and 4 after surgery. In the control group, routine treatment similar to that of the experimental group without laser irradiation was administered. The patients were advised to take medication after surgery (500mg amoxicillin capsules every 8 hours for 7 days, 400-mg ibuprofen tablets every 8 hours if they experienced pain and a 0.12% chlorhexidine mouthwash twice a day for 10 days). The result showed that pain and swelling were significantly lower in experimental group compared to the control group [13].

Martinez et al. has done a clinical trial on the effectiveness of helium-neon laser in the prevention of pain, swelling, and trismus after third molar surgery. In this study, 100 patients randomly received neon-laser, ibuprofen, and placebo. They found that trismus significantly reduced in neon-laser and ibuprofen groups, but pain in ibuprofen group compared to placebo and laser was less. However, inflammation was the same in all three groups [25].

In the study by Kazancioglu et al., the effect of ozone and laser use in controlling swelling, pain, and trismus after third molar surgery was evaluated. In this study, 60 patients with asymptomatic impacted third molars were studied. The patients were randomly divided into 3 groups of 20: first group was treated with LLLT with a wavelength of 810 nm and 200 mW power for 30 seconds, and the second group was treated with ozone. The last group was the control group. Pain level and the number of painkillers used in the ozone and laser groups were lower than the control group. Trismus in LLLT group was significantly lower than that of ozone and control. Group treated with ozone showed no superiority in reducing the swelling after surgery. This is while LLLT group showed a significant reduction in swelling after surgery. This study shows that the use of ozone and LLLT in reducing postoperative pain and improving the quality of life of patients is beneficial. After surgery, the patients were prescribed 1,000 mg amoxicillin and 550 mg naproxen sodium

orally as necessary and an aqueous 0.2 % chlorhexidine mouth rinse (1 min, three times daily) for seven days. Also each patient received an icepack to put on to the surgical area for 30 min after surgery [14].

In the study by Goran Batinjan et al., the goal was to study the effect of adjuvant anti-inflammatory effect of photo-dynamic therapy and low-level laser on wound healing, pain, swelling, bad breath, and the use of painkillers after lower wisdom tooth surgery. The results showed that the use of laser with a power of 3 kW, 660 nm energy, and density of 4 J considerably reduced the use of painkillers after surgery for the studied period. The result showed that laser therapy considerably reduced lower-wisdom teeth postoperative problems, due to the excellent results in the group treated with laser [26].

The disagreements observed among the results of mentioned studies could be attributed to the use of different laser parameters, such as wavelength, power, energy and energy density, the frequency and duration of laser radiation, intraoral versus extraoral application, area of irradiation and received medical regime before and/or after surgery.

Conclusion

According to the results of the analysis of the data obtained and under limitations of this study, using low-power laser with a wavelength of 550 nm (power = 100 mW, laser energy = 2.5 J per area, energy density = 5 J/ cm^2, spot size = 0.5 cm^2) reduces pain, swelling, and trismus after surgical removal of impacted mandibular wisdom, but not statistically significant. Moreover, low-power laser with the mentioned conditions numerically decrease pain, swelling, and trismus until the seventh day that was statistically significant.

Suggestions

In other clinical trials:

1. Low-level lasers with different wavelengths and different powers can be used to reduce pain, swelling and trismus.
2. The adjuvant effect of low-level lasers can be used in patients who require bilateral lower third molar surgery.

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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Ethical Approval

The study protocol was approved by Ethics Committee of Tabriz University of Medical Sciences and Iranian Registry of Clinical Trials; number (IRCT 2016091329785N2). Informed consent has been obtained from all patients as well.

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