EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org
VOL. 71, 155:163, JANUARY, 2025
PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360
ORAL SURGERY
Submit Date : 08-10-2024 • Accept Date : 01-11-2024 • Available online: 01-01-2025 • DOI : 10.21608/edj.2024.320938.3219

EFFECT OF PREOPERATIVE LASER THERAPY ON TRISMUS, SWELLING AND PAIN FOLLOWING THE EXTRACTION OF IMPACTED LOWER THIRD MOLARS: A RANDOMIZED CLINICAL TRIAL.

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ABSTRACT

Aim: This research aimed to evaluate the efficacy of a preoperative Low-Level Laser Therapy (LLLT) protocol in managing pain, edema, and trismus related to the surgical removal of impacted lower wisdom teeth.

Methodology: Thirty participants were included into this investigation and then randomized into three groups. The control group included patients managed by routine surgical treatment. Other patients were allocated into the laser groups were group 1 included patients receiving LLLT immediately post-surgery. Group 2 included patients who received LLLT pre- and post-surgical removal of the impacted wisdom. Pain, trismus, and facial edema were evaluated immediately after the surgery, as well as on the second and seventh days following the procedure.

Results: The percentage of decrease in pain was greatest in group 2, followed by group 1, and lowest in control group. Pre-operatively to 7th day facial swelling percentage change indicated that the control group had the greatest increase, followed by group 1 and group 2 with the lowest increase. The percentage change in mouth opening from pre-operatively to 7th day indicated that control group had the biggest decrease, followed by group 1 and group 2.

Conclusion: It appears that the pain-relieving effect of LLLT is enhanced by a preoperative irradiation immediately prior to the extraction. A preoperative dose of LLLT also appears to be beneficial in reducing trismus and facial swelling when compared to a single postoperative dose.

KEYWORDS: Low-level laser therapy, Pain, Swelling, Trismus, Third molar extraction.

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INTRODUCTION

The most common and frequent surgical procedure in oral and maxillofacial surgery field is the extraction of impacted mandibular third molars [1]. This procedure has been associated with postoperative transitory problems of varying degrees of severity, including pain, edema and trismus [2]. Numerous variables contribute to these conditions, but they are all derived from an inflammatory process triggered by surgical damage to the alveolus and the surrounding soft tissues and muscles. The feeling of pain peaks 3 to 5 hours post-surgery, last for 2 to 3 days, and progressively subsides by the seventh day [3]. Swelling and Limited mouth opening peak in severity between 12 to 48 hours, subsiding between the fifth and seventh day [4].

Medications as corticosteroids and non-steroidal anti-inflammatory are often prescribed before and after extraction, but most of them have side effects such as gastric pain or ulcers and may be responsible for some allergic response. The presence of such adverse effects opens the way for the use of adjunctive modalities specifically the biomodulation with diode laser therapy [5; 6].

The supplementary use of LLLT enhances analgesic and anti-inflammatory properties that improve wound healing and reduce postoperative pain and edema without side effects [4] [7; 8]. LLLT modifies the arachidonic acid pathway to lower prostaglandin (PGE2) levels and TNF activity dose-dependently. [9; 10] Laser analgesia is caused by endorphin production, reduction of type C nerve fiber activity and bradykinin reduction, and pain perception threshold modification [11; 12]. Lasers have been demonstrated to be more effective than some systemic drugs in pain control. LLLT also boosts phagocytic activity, normalizes vascular wall permeability, increases lymphatic channel number and width, and lowers edema [13].

A variety of research has been carried on the efficacy of the 940 nm Diode laser on bone healing and pain reduction [14; 15]. It was reported that LLLT using 940 nm diode laser was useful in reducing pain and swelling. Moreover it was shown to be effective in bone healing and remodeling [16].

The majority of studies in the literature investigated the impact of LLLT on the third molars only after the extraction, and only a small number of studies assessed the effects of laser bio-stimulation both before and after the surgery [4,7,9 ,17]. The variety of postoperative inflammatory complications and the severity of the postoperative recovery period were reduced by preoperative low-intensity laser therapy as shown in a recent study [18].

Aim of the study:

This research aimed to evaluate the efficacy of a preoperative Low-Level Laser Therapy (LLLT) protocol in managing pain, edema, and trismus related to the surgical removal of impacted lower wisdom teeth.

MATERIALS AND METHODS

Ethics

The research protocol of study has been registered, reviewed and approved by the ethics committee (EC). Faculty of Oral and Dental Medicine, Ahram Canadian University.

Research Number: IRB00012891#38

Study design:

A randomized, controlled, Double-blind, clinical trial was carried out in outpatient clinic at the faculty of Oral and Dental Medicine, Ahram Canadian University. Thirty patients between the age of 18 and 30 years were included into the study, all subjects were selected from patients coming for the purpose of removal of the mandibular third molar and were informed of the possible hazards of the surgery and LLLT treatment and signed an informed consent form.

All the patients included in the study were subjected to open flap, odontotomy and osteotomy. The exclusion criteria consisted of the following: the presence of systemic disease, chronic pain, or neurological/psychiatric disorder; current smoking habit; use of an anti-inflammatory agent, analgesic, or bisphosphonate drug; pericoronitis within the past month; pregnancy or current breastfeeding; or a history of photosensitivity disorders. Furthermore, the study excluded patients who had consumed analgesics or anti-inflammatory medications within 24 hours prior to surgery.

Sample size:

The sample size was determined by referring to a previous study (19). The minimally acceptable sample size was 8 per group, as per this study, when the difference in the response of matched pairings is normally distributed with a standard deviation of 4.2. When the power is 80% and the type I error probability is 0.05, the true difference in the mean response of matched pairings is 5.1. In order to account for a 15% dropout rate, the size of the sample was increased to nine per group. Each group consisted of a total of 10 patients.

Patient Grouping:

The patients were randomly allocated into three groups (10 in control group and 10 in each experimental subgroup):

Control group: Patients treated with traditional surgical procedure followed by postsurgical care and instructions without any adjunctive LLLT irradiation.

Group 1: Patients subjected to LLLT irradiation immediately after the surgical procedure followed by postsurgical care and instructions.

Group 2: Patients subjected to LLLT irradiation immediately before and immediately after the surgical procedure followed by postsurgical care and instructions.

Surgical difficulty:

The difficulty score of the surgical procedure was determined according to the Sammartino et al. index (20). Only teeth with medium difficulty score (13 – 17.5 points) were included in the study.

Preoperative measurements:

Facial measurements were measured and recorded for each patient before the surgery. Three lines were measured in accordance with the specifications provided by Amarillas- Escobar et al [(9)]. L1 was the distance between the eye corner and the mandibular angle, L2 between the commissure of the lip and the tragus, and L3 between the tragus and pogonion. Mouth opening Prior to surgery was measured using a caliper between the incisal edges of the lower and upper central incisors.

LLLT Device and protocol:

A 300-μm handpiece connected to a diode laser device (model: EPIC X™ by BIOLASE®, USA) with a continuous emission of 940 nm InGaAsP was applied. Laser was applied at 500 mW (0.5 Watt) for a total of 180 seconds, 60 seconds for each point, The total energy applied was 90 Joules, calculated as 0.5 Watt ×180 seconds. Each session of LLLT was divided into an intraoral and an extra-oral phase. Laser was applied extra-orally for 60 seconds at a distance of 1 cm from the skin over the masseter muscle, which included the origin, insertion, and body, on the side that surgery. Next, the laser was applied intra-orally for 60 seconds on the lingual side of the alveolus of the teeth that were to be extracted, followed by an additional 60 seconds on the vestibular wall. The laser was operated in circular motions while maintaining a consistent distance from the tissues.

In order to make sure that patients were blinded to the treatment they were receiving, the laser apparatus's handpiece was applied inside the mouth and on the side of the face to all patients (both pre- and post-operatively). However, the

device was only activated at the appropriate time, as determined by the random allocation process. The evaluators assessed the patients' edema, mandible opening, and discomfort at 2 and 7 days following the surgery.

Surgical procedure:

Mepivacaine 2% local anesthetic cartridge with adrenaline 1:100,000 (Septodent®, France) was injected into the inferior alveolar, lingual, and long buccal nerves to perform the mandibular third molar extractions under local anesthesia. Three-sided (trapezoidal) mucoperiosteal flap was incised and reflected to expose the tooth, a surgical bur in a surgical straight handpiece with saline irrigation was used to remove the bone. A significant amount of normal saline (0.9%) was used after tooth delivery. The flap was repositioned, and the wound was closed.

All patients were instructed to apply ice packs to the buccal area on the operative side at 10-minute intervals and take 150 mg of Ketoprofen (Sanofi Aventis) orally twice daily after surgery. Chlorhexidine gluconate mouthwash was recommended three times a day from surgery to suture removal seven days later.

Postoperative outcomes:

- ***Evaluation of postoperative pain***

This outcome was assessed 2- and 7-days following surgery using a visual analog scale (VAS). Pain was recorded as "0" when no pain is felt (patient experiences no discomfort) to "10" maximum pain (very noticeable pain which disturbs the patient's daily routine).

- ***Evaluation of postoperative swelling***

In the present study, three lines will be measured. L1, L2 and L3: of each patient 2- and 7-days following surgery. Then an average measurement was calculated for the three-line measurements.

- ***Evaluation of postoperative muscle spasm***

This outcome will be assessed by measuring the distance between the incisal edges of the upper and lower central incisors using a caliper. The mouth opening was measured in each patient at 2- and 7-days following surgery.

Statistical Analysis:

Statistical analysis were conducted using the Statistical Package for Social Sciences (SPSS) version 20. Numerical data were summarized using the mean, standard deviation, median, and range. The data were assessed for normality by examining the distribution and used the Kolmogorov-Smirnov and Shapiro-Wilk tests. The comparisons between groups for normally distributed numeric variables were conducted using the ANOVA test, followed by the Bonferroni post hoc test for pairwise comparisons. The percentage change was determined using the formula: (value after - value before) / value before × 100. Qualitative data were represented as counts and percentages and analyzed using the chi-square test. All p-values are bilateral. P-values less than or equal to 0.05 were considered significant.

RESULTS

Assessment of pain

The mean VAS value recorded for postoperative pain showed a significantly lower value at 7th day in comparison to 2nd day, in control group (p=0.027), in group 1 (p=0.024) and in group 2 (p=0.023). On the other hand, the percentage of change (from 2nd to 7th day) showed that the greatest percent decrease (highest decrease in pain) was recorded in group 2 (-62.22±14.21), followed by group 1 (-47.22±9.29), with the lowest percent decrease recorded in control group (-43.35±12.08). The percent decrease recorded in Group 2 was statistically significant compared to the other 2 groups (p=0.038)

TABLE (1) Mean ±SD, median and Range of Visual analogue scale (VAS) , intergroup (ANOVA test) and intragroup comparison (paired t test)

Group	2nd day		7th day		P value (intragroup)	Percent change	
	Mean ±SD	Median {Range}	Mean ±SD	Median {Range}		Mean ±SD	Median {Range}
Control	7.17[a]±.75	7{6; 8}	4.00[a] ±.63	4{3; 5}	.027*	-43.35[b] ±12.08	-42.9 {-62.5; -28.6}
Group 1	5.33[b]±.82	5.5 {4; 6}	2.83[b] ±.75	3{2; 4}	.024*	-47.22[b] ±9.29	-50 {-60; -33.3}
Group 2	3.83[c]±.75	4{3; 5}	1.50[c] ±.84	1{1; 3}	.023*	-62.22[a] ±14.21	-66.7 {-75; -40}
P value (Intergroup)	.000*		.000*			.038*	

Significance level p≤0.05, *significant

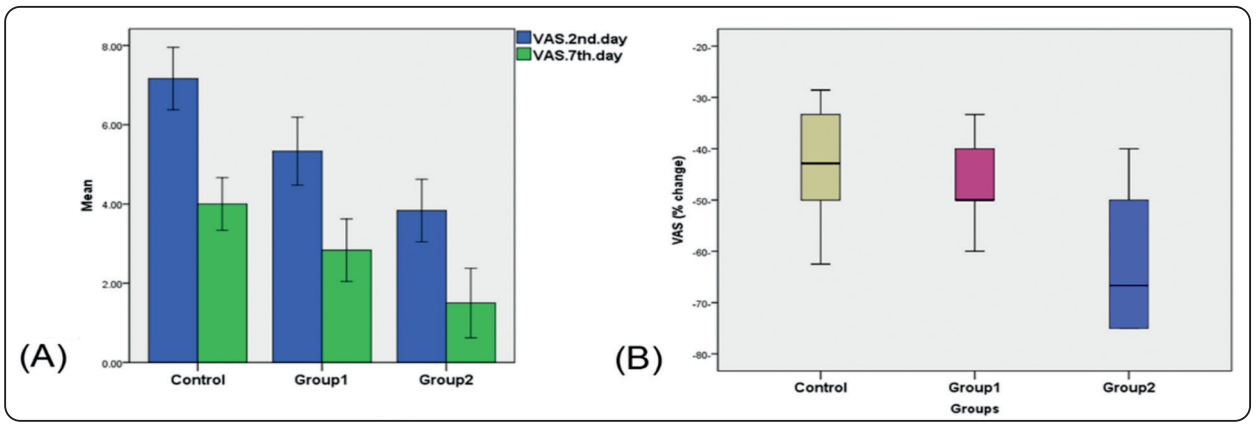

Fig. (1) (A) Bar chart showing the differences in mean value of VAS across groups. (B) Box plot demonstrating median value of percent change of VAS in different groups.

Assessment of facial swelling:

Within the same group, the mean facial swelling value revealed a significant increase on the 2nd day, followed by a decline till the 7th day to a value comparable to the pre-operative value. The effect of time was statistically significant in control group (p=0.002), in group 1 (p=0.002) and in group 2 (p=0.003). The difference between groups on the 7th day was not statistically significant (p=0.025). Nevertheless the percentage of change from pre-operatively to 7th day showed that the greatest increase of the facial swelling was recorded in the control group (4.56±1.74), followed by group 1 (2.41±1.09), with the lowest percent increase recorded in group2 (.99±.47). The difference between groups was statistically significant (p=0.002)

TABLE (2) Mean ±SD, median and Range of percent change in facial swelling and intergroup comparison (Kruskall Wallis test)

Group	% change in first interval (Pre-operative to 2nd day)		Overall % change (Pre-operative to 7th day)	
	Mean ±SD	Median {Range}	Mean ±SD	Median {Range}
Control	10.39[a]±1.67	10.49 {8.14; 12.2}	4.56±1.74	4.46{2.89: 6.88}
Group 1	5.57[b]±2.49	5.45{1.72: 9.52}	2.41±1.09	2.36{.49: 4.76}
Group 2	3.22[b] ±1.35	2.96{1.72; 5.26}	.99±.47	0.68{0; 2.26}
P value (Intergroup)	.000*		.002*	

Significance level p≤0.05, *significant

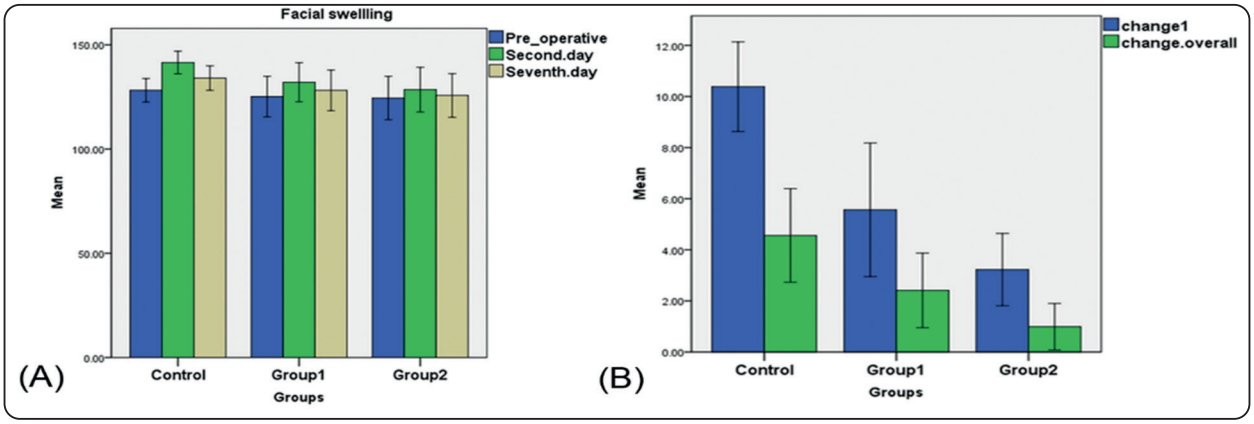

Fig (2) (A) Bar chart illustrating mean value of facial swelling in different groups (B) Bar chart illustrating mean value of percent change in facial swelling in different groups

Assessment of mouth opening:

For group 1 and group 2 the mean mouth opening value showed a significant decrease 2 days after surgery, while on the 7th day the mouth opening changed to a value comparable to the pre-operative value. The effect of time was statistically significant in group 1 (p=0.003) and in group 2 (p=0.004). The percentage of change from pre-operatively to 7th day showed that the greatest decrease in mouth opening was recorded in control group (-17.4±10.91), followed by group 1 (-7.27±6.98), with the lowest percent increase recorded in group2 (-1.91±3.04). The percent decrease recorded in control group was significantly greater than in group 2 (p=0.01)

Table (3): Mean ±SD, median and Range of percent change in mouth opening and intergroup comparison (Kruskall Wallis test)

Group	% change in first interval (Pre-operative to 2nd day)		Overall % change (Pre-operative to 7th day)	
	Mean ±SD	Median {Range}	Mean ±SD	Median {Range}
Control	-54.44[a] ±5.39	-56.12 {-60.78; -46.15}	-17.4[a]±10.91	-17.26 {-30.61;-4.26}
Group 1	-21.08[b] ±11.80	-22.99 {-38.64; -4.65}	-7.27[ab]±6.98	-4.65 {-16.33; 0}
Group 2	-18.49[b]±24.73	-6.25 {-65.91;-2.38}	-1.91[b]±3.04	0 {-6.82; 0}
P value (Intergroup)	.002*		.01*	

Significance level p≤0.05, *significant

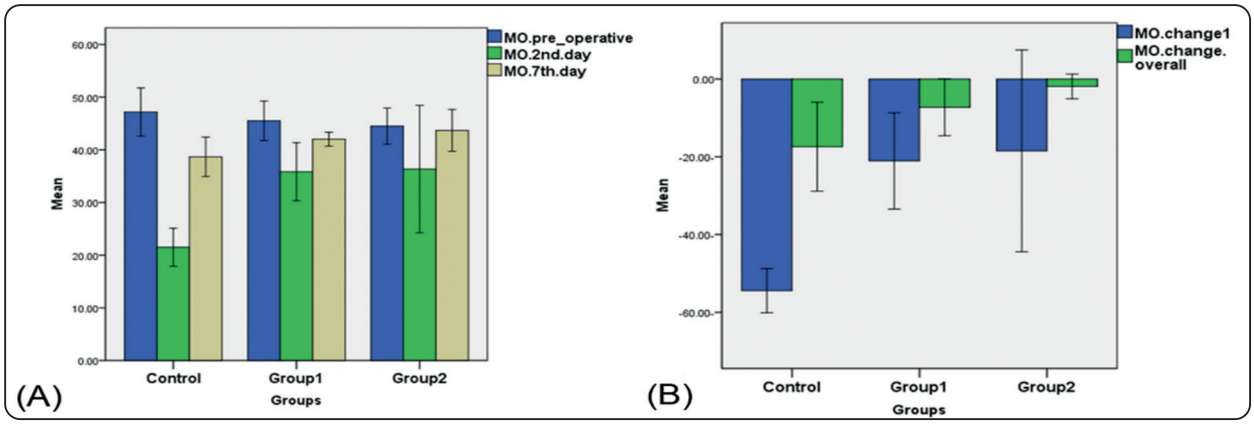

Fig (3) (A) Bar chart illustrating mean value of mouth opening in different groups (B) Bar chart illustrating mean value of percent change in mouth opening in different groups

DISCUSSION

This study is designed to evaluate the combined effect of preoperative and postoperative LLLT on mitigating postoperative complications after extracting impacted wisdom teeth surgically. Pre-operative LLLT has been suggested in the literature to reduce post-operative inflammation, yet it has not been sufficiently studied.

In this study, the parameters used of the laser device applied didn't produce any undesirable effects and all patients in the control and study groups showed uneventful healing with no permanent complications.

In comparison to the control group, the pain intensity score of the laser groups was lower on the second postoperative day. Also, the rate of pain reduction in both laser groups from the second to seventh day postoperatively was greater than that of the control group. This difference was statistically significant confirming the analgesic effect of LLLT. This is in accordance with Landucci et al[21]. Santos et al [12] and Feslihan et al with the latter finding no statistically significant difference between the application of postoperative laser and corticosteroids[22]. Moreover, the second study group (pre and immediate postoperative laser) had statistically significant lower pain intensity score than the first study group (immediate postoperative). Our results are not in accordance with Petrini et al [17], who didn't find any statistically significant difference between the pre- and postoperative and the postoperative only groups in decreasing the amount of pain. This disagreement is probably caused by the dissimilarity in analgesic consumption protocol between the two studies; they reported reduction in the amount of ketoprofen consumption in the pre and postoperative group in the first 24 hours in comparison to the postoperative only group, while, in our study, we maintained the same dose of ketoprofen consumption among all groups in the first three postoperative days.

Regarding the facial swelling, the second study group showed notably less edema than the control group at the second post-operative day. Also, this group showed more significant resolution in facial edema from second to seventh post-operative day than the control group. This may be accredited to the effect of LLLT on lymphatic vessels, the decrease it causes in the blood vessels and the regaining of microcapillary circulation, neutralizing the permeability of the vascular wall. This is not similar to the findings of Pol et al [23]. who found no significant difference between the control and laser group. This may be attributed to their less points of laser application and the resulting less laser energy, while in our study, we opted for 3 points of intra and extra-oral laser application with increased

laser energy. Nonetheless, there was no significant difference between the two study groups. This is in accordance with Petrini et al. where the addition of preoperative laser to the immediate post-operative didn't significantly contribute to the resolution of edema.

In the current study, on comparing mouth opening between groups, both study groups showed significantly less decrease in mouth opening relative to the control group at the 2nd postoperative day. Also, these two groups showed greater increase in the mouth opening from second to seventh postoperative day in comparison to the control group. This may justified by the relaxing LLLT effect on the masseter muscle that has been irradiated in our research. This is not similar to Singh et al [24] who found a statistically significant difference in postoperative pain and edema, but not in trismus between control and laser groups. This could be explained by the difference in laser irradiation protocol between the two studies. Also, not in accordance with Pol et al [23] who found no significant difference in degree of trismus between laser and control group. This may be attributed to the intra-oral laser application only and not irradiating the masseter and other elevator muscles. Although the second study group showed better resolution of trismus at the seventh post-operative day compared to the first study group, the difference between them was non-significant. This is in accordance with Petrini et al who reported similar results. This might be a consequence of applying laser on the masseter muscle only and not the rest of the elevator muscles which might have been affected by the prolonged mouth opening during the surgery and the inflammation, which may have minimized the effect of laser application before the fatigue-inducing incident [17].

CONCLUSION

The results of the study demonstrate that low-level laser therapy is effective in reducing the incidence of postoperative complications, including trismus, edema, and pain.

It appears that the pain-relieving effect of LLLT is enhanced by a preoperative irradiation immediately prior to the extraction. A preoperative dose of LLLT also appears to be beneficial in reducing trismus and facial swelling when compared to a single postoperative dose.

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